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MEDICAL AND SOCIAL ANALYSIS OF CHILD MORBIDITY IN SEPARATE RURAL DISTRICTS OF THE TERRITORY OF DNEPROPETROVSK REGION BY THE LONG-TERM ANNUAL AVERAGE INDICATORS

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The author has carried out medical and social analysis of child morbidity at the age of 14 by the long-term annual average indicators in the separate taxons of the territory of Dnepropetrovsk region during 2007-2012. Level of child morbidity was analyzed in accordance with ICD-X classes by the following indicators: average annual, intensive, extensive; the growth rates of the disease were calculated.

Keywords: medical and social analysis, morbidity, taxons, child population, ICD-X disease classes, growth rate.

Conference participant, National championship in scientific analytics, Open European and Asian research analytics championship


МЕДИЦИКО-СОЦИАЛЬНЫЙ АНАЛИЗ ЗАБОЛЕВАЕМОСТИ СРЕДИ ДЕТЕЙ В ОТДЕЛЬНЫХ СЕЛЬСКИХ РАЙОНАХ ТЕРРИТОРИИ ДНЕПРОПЕТРОВСКОЙ ОБЛАСТИ ПО УРОВНЯМ СРЕДНЕМОГОЛЕТНИХ ПОКАЗАТЕЛЕЙ

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Проведён медико-социальный анализ показателей заболеваемости среди детского населения в возрасте до 14 лет, по уровням среднемоглетних показателей в отдельных таксонах Днепропетровской области в течение 2007 – 2012 гг. Анализировали уровень заболеваемости по классам МКБ – X среди детей по показателям: среднемоглетним, интенсивным, экстенсивным; рассчитывали темпы прироста заболеваний.

Ключевые слова: медико-социальный анализ, заболеваемость, таксоны, детское население, классы болезней по МКБ – X, темпы прироста.

Участник конференции, Национального первенства по научной аналитике, Открытого Европейско-Азиатского первенства по научной аналитике

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Foreword. On the recent years in Ukraine demographic situation worsened on a background of negative trends as well as genetic processes flow in the population [1]. Patients' amount in Ukrainian population increased on 25 %, totally population decreased by 4 million people. Non-infectious, i.e. oncological incidence among the population has tendency to growth on (2.6-3) % annually [2, 3]. National hygienic issue today is to estimate economic losses due to deteriorating of the population health indicators [4]. One of the national problems in modern medicine is complex demographic situation, which is implemented on a background of negative trends, caused by genetic processes flow in the population and increasing cases of genetic hereditary diseases [5-7]. Most mortality is related to cardiovascular diseases (60 %), followed by cancer (12 %), and external causes including accidents and poisonings (9.7 %); these three causes account for 81.8 % of all deaths in Ukraine. Health – adjusted life expectancy (HALE) is not routinely calculated; international research conducted in 2003 found that in 2002 HALE was 54.9 years for men and 63.6 years for women in Ukraine [8]. Infant mortality rose between 1991 and 1995, but then fell by a third between 1995 and 2006 [9]. Research

conducted by the Ministry of Health and National Institute for Strategic Studies also revealed that the number of neonates weighing between 500 g and 999 g decreased by half in the 2006 – 2007 period. Analyses also showed a significant increase in the survival rate of these infants (from 36.4 to 50.3 per 1000 live births), despite continued problems with access to neonatal intensive care equipment. The early neonatal death rate and maternal mortality have both halved since independence [10].

Materials and methods. According to the distribution 22 territorial districts of Dnepropetrovsk region were classified into 6 types of rural districts, according to the Scheme of settlements planning in the Dnepropetrovsk region. The first type of rural districts covers the following settlements (Kryvorozskyi and Novomoskovskyi); second type of rural districts (Nikopolskyi and Pavlogradskyi); the third type of rural districts covers (Dnepropetrovskyi rural area); the fourth type (Vasylkivskyi, Krynychanskyi and Synelnikovskyi districts); the fifth type (Verchedneprovskyi, Mezewskyi, Petrikovskiy, Piatykhatskyi, Sofiivskyi and Shyrokiivskyi districts); the sixth type (Apostolivskyi, Mahdalynivskyi, Petropaulivskyi, Pokrovskyi, Solonianskyi, Tomakivskyi, Tsarychanskyi and Yuriivskyi rural districts). Medical and

social analysis of children's morbidity at 14 y.o. age, by average annual indicators, in the separate rural districts on the territory of Dnepropetrovsk region during 2007 – 2012 years, according to the statistical reports of Dnepropetrovsk regional health care center.

Results and discussion. In the structure of children population morbidity, 14 years old, diseases at whole occupy the first rank place (100 %). While morbidity at the children – living in 1 rural districts of Dnepropetrovsk region significantly determined on the level (11024.76±305.57) cases per 10.000 children, by an average annual indicator since 2007-2012 years ($p < 0.001$). Growth rates of whole diseases at 1st district carried out on the level +2.9 % on average in all districts and -16.8 % in Dnepropetrovsk region. The highest level of all diseases was significantly observed at 2nd rural district: 11910.33±393.92 cases per 10.000 children population ($p < 0.05$), with typical positive growth rate per average amount in all rural districts +11.1. The lowest level of all diseases was significantly observed in 6 rural district: 9482.96±399.20 cases per 10.000 children population ($p < 0.05$), with negative growth rates in both whole districts -11.5 % and in Dnepropetrovsk region -28.4 %.

Second rank position in the structure

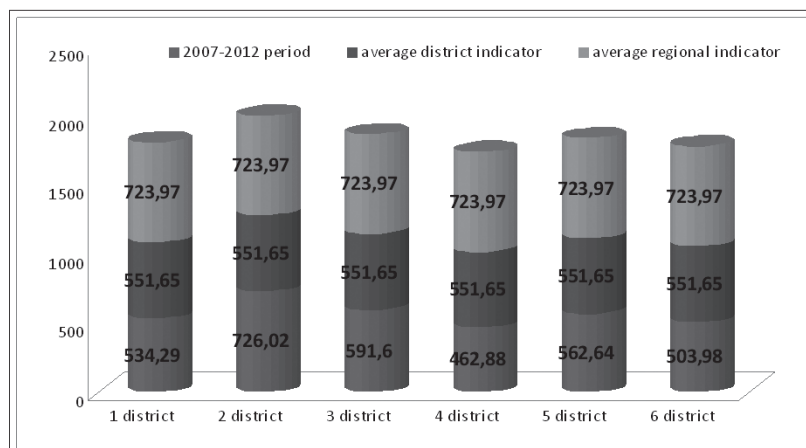


Fig. 1. Incidence of 14 y.o children population on skin and subcutaneous tissue diseases, by levels of annual indicators, in the rural districts of Dnepropetrovsk region during 2007 - 2012 period (cases per 10.000 children).

of morbidity among population of children living in 1 district, probably occupy respiratory system diseases (7205.40 ± 204.73) ‰ ($p < 0.001$), with typical positive growth rate in average whole districts as well as +6.2 % and negative growth rate -16.3 % per region. The highest prevalence among children population X class of diseases occurred in 3rd district and was significantly revealed on the level (7735.50 ± 188.12) ‰ ($p < 0.05$), with a high growth rate per rural settlements +14.1, and negative growth rate per region -10.2. Percent for X class of diseases in 1 district was carried out as 65.36 %, whereas in 3 district varied as well as 66.29 %.

Third rank place in 1 district carried out diseases of the skin and subcutaneous tissue, i.e. was on the level 4.85 %. Primary morbidity level towards XII

class of diseases (1 district), by average annual indicator, was significantly mean 534.29 ± 44.07 ‰ ($p < 0.05$), with negative growth rates in both the whole districts -3.1 %, and in Dnepropetrovsk region -26.2 % (Fig. 1).

Moreover, our study have been shown that the highest rate of incidence XII class of diseases in 2 rural district was positive (+31.6 %), at the morbidity level (726.02 ± 89.13) ‰ ($p > 0.05$). Positive growth rate for this class of diseases among children was observed in the region up to +0.3. Analysis levels of children morbidity in 2 district shows the highest growth towards diseases of the endocrine (+130.9 %), nervous (+56.5 %), musculoskeletal system (+75.9 %), genitourinary system (+22.9 %), congenital anomalies (malformations) (+25.2%), and congenital anomalies of

the circulatory system (+55.2 %), with a high growth rates on average by districts.

Our interest have been focused on reduction of the children morbidity in 2 district with a negative growth rate, which was observed for the following diseases as well as blood and hematopoiesis system (growth rate -13.5 %), anemia (-12.6 %), digestive system (-25.1 %). However, the low decrease of neoplasm's incidence (-6.8 %) was revealed in 2 district during 2007-2012 years.

We were able to show that among the children population – inhabitants of 3 district until 2007-2012 years was carried out a positive rate incidence of diseases such as respiratory system (+14.1 %), digestive (+2.3 %), skin and subcutaneous tissue (+7.2 %). In 3 district has a great importance tendency of negative growth these diseases as well an infectious and parasitic (-39.3 %), neoplasm's (-31.1 %), blood and hematopoiesis system (-20.0 %), anemia (-19.5 %), endocrine system (-29.6 %), nervous (-28.7 %), circulatory (-35.4 %), musculoskeletal (-48.0 %), genitourinary (-5.9%) systems, congenital anomalies (malformations) (-32.0 %) and congenital anomalies of the circulatory system (-33.7 %).

However, it is becoming clear that an incidence rates some classes of diseases among children at 14 years old in all rural districts showed the lowest level characterized for the infectious and parasitic diseases during 2007 - 2012 years in 3 district, should be on the level (246.72 ± 15.55) ‰ ($p < 0.05$), while the highest level I class of diseases was observed in 2 district (549.27 ± 52.90) ‰. As shown in (Fig. 2), an average annual level this class of diseases exceeded the average regional level of incidence (533.10 ± 38.75) ‰ in 1.03 times and average district level (410.68 ± 31.68) ‰ in 1.34 times.

Incidence of tumors among children under the age of 14 years was significantly highest by an annual indicators in 1 district: 19.92 ± 1.81 ‰ ($p < 0.05$) and 5-district: 19.59 ± 3.04 ‰ ($p < 0.001$). In this case, II class of disease exceeded meaning of an average district level 16.92 ± 0.48 ‰ in 1.78 times (1 district) and in 1.02 times (5 district), with a positive growth rates by districts: from + 17.7 to +15.8 %. Generally, II class

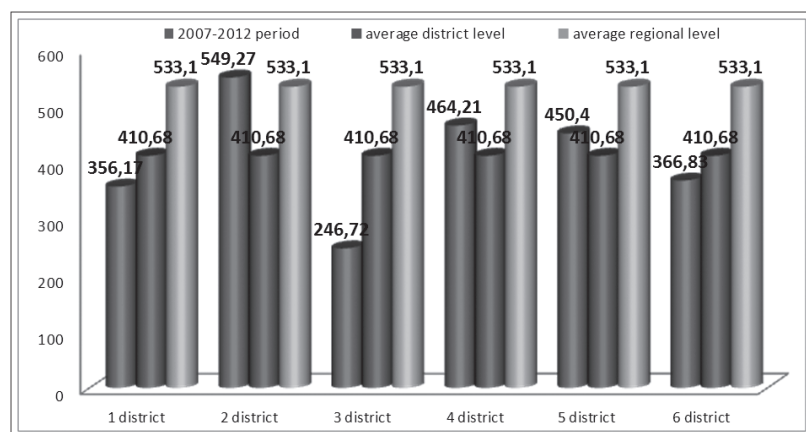


Fig. 2. Incidence of 14 y.o children population on the infectious and parasitic diseases, by levels of annual indicators, in the rural districts of Dnepropetrovsk region during 2007 - 2012 period (cases per 10.000 children).

of disease incidence among children population shouldn't exceed an average level of morbidity (25.20 ± 0.39) ‰ by the whole districts in Dnepropetrovsk region ($p < 0.001$) (Fig. 3).

During 2007 - 2012 years has been carried out a negative growth rate of tumors at the following settlements as well as in 1 rural district (-20.9 %), 2 district (-37.5 %), 3 district (-31.1%), 4 district (-33.8 %), 5 district (-22.3 %), 6 district (-29.2 %) (Fig. 3). Structure of tumors among 14 y.o. children in some of Dnepropetrovsk region districts was the following: from 0.09% in the 3rd-district to 0.21% in the 4th district.

Dynamics of morbidity considered significant increasing of blood and hematopoiesis system diseases in the territory of Dnepropetrovsk region among children population: from 156.90 ± 11.76 cases in 1 district ($p < 0.05$) to 289.71 ± 32.72 cases per 10.000 children in 6 district. Proportion of intensity this pathology in some districts of the region increases from 1.42 % in the 1 rural settlement to 3.05 % in the 6 district. Primary, there is a positive growth rate has been shown on average by some of the districts covered III class of diseases, as well as in the 5 district (+3.3 %) and 6 district (+24.9 %), which incidence exceeds average level for this class of pathology by whole districts in 1.03 - 1.25 times. Positive growth rate typical for III class of diseases, carried out for average regional levels correspond as +24.5% in 5 district and +50.6 % in 6 district, with exceeding of an average regional meaning in 1.25 - 1.51 times.

Tendency of significant increase cases of anemia at 14 y.o. children was revealed: from 155.12 ± 11.42 ‰ ($p < 0.05$) cases in the 1 district to 286.68 ± 32.59 ‰ cases in the 6 district. Trend of negative growth anemia occurs in the following rural settlements: on 32.2% in 1 district; 12.6% - 2 district; -19.5 % - 3 district; -20.9 % - 4 district. Positive growth rate towards III class (D50-D53) of diseases was typical in the 5 and 6 districts, respectively, from +2.5 to +25.2 % (by the whole districts) and from +25.2 to +52.9 % (by the region) (Fig. 4). In both Dnepropetrovsk region districts, incidence of this class of diseases exceeded average level of

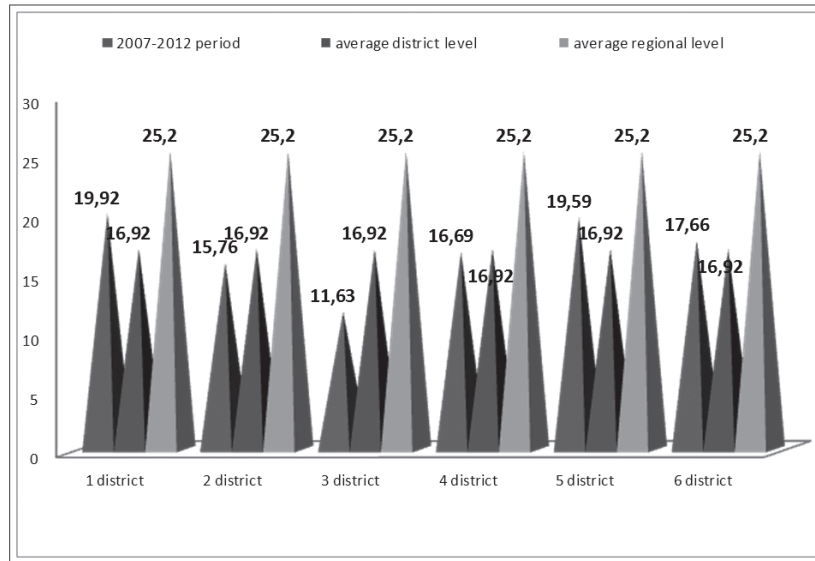


Fig. 3. Incidence of 14 y.o children population on tumors, by levels of annual indicators, in the rural districts of Dnepropetrovsk region during 2007 - 2012 period (cases per 10.000 children).

morbidity: in 1.02 - 1.25 times (in the whole districts) and in 1.25 - 1.53 times (in the region).

Proportion of genitourinary system diseases in the whole structure of diseases among children at the age of 14 years old was varied in some rural districts: 1.73 % (1 district); 2.29 % (2 district); 1.80 % (3 district); 2.86 % (4 district); 2.35 % (5 district); 2.47 % (6 district). The lowest level XIV class of diseases was registered in the 1 district: 190.84 ± 20.75 ‰, with negative growth rates in both settlements -14.4 %, and in the region -32.1 %. The highest level this class of diseases among children was observed in the 2 district: 273.89 ± 23.72

‰, with positive growth by the districts +22.9% and negative growth rate by the region -2.6 %. Finally, diseases of the genitourinary system exceeded it correspond level (in the whole districts) in 2 district (1.23 times); 4 district (1.0 times); 5 district (1.18 times); 6 district (1.05 times).

Incidence of children at 14 years old in a case of congenital circulatory system anomalies was the highest in the 2, 4 and 6 districts, which should exceed both average district – region levels of morbidity by some rural settlements: 2 district (1.55 – 1.73) times; 4 district (1.26 – 1.41) times; 6 district (1.26 - 1.41 times). The highest growth rate

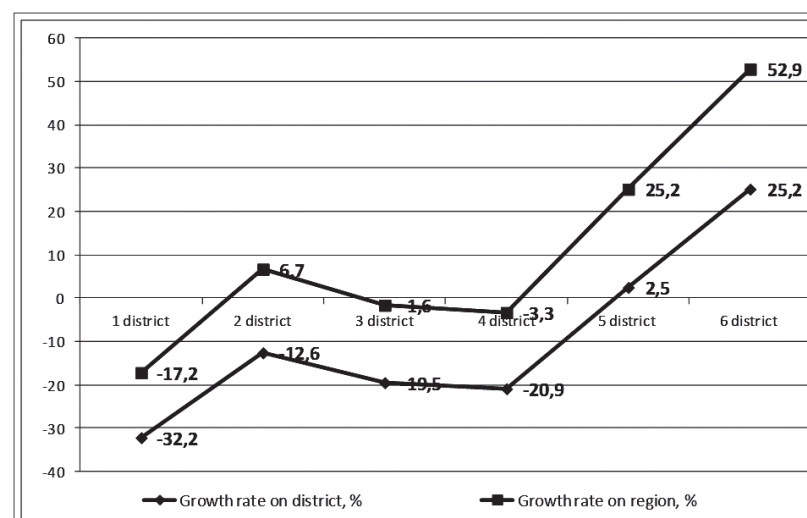


Fig. 4. Growth rates of anemia among 14 y.o. children in the rural districts of Dnepropetrovsk region during 2007 - 2012 period.

diseases of XVII class (Q20-Q28) were observed: by districts average levels – in the 2 district (+55.2 %), by regional average level (+73.1 %); in the 4 district - by districts average levels (+26.0 %), by regional average level (+40.6 %); in the 6 district - by districts average levels (+26.4 %), by regional average level (+41.0 %). For other districts were experienced negative growth rates during 2007 – 2012 years: in the 1 district - by districts average levels (-16.2 %), by regional average level (-6.5%); in the 3-district - by districts average levels (-33.7 %), by regional average level (-26.1 %); in the 5 district - by districts average levels (-22.2%), by regional average level (-13.2%).

Conclusions. We have found out that the structure of morbidity among children in different rural districts differs on some classes of diseases. Moreover, in the 1 district the largest proportion was confirmed for the following classes of diseases as well as X (65.36 %), XII (4.85 %), XI (4.42 %), I (3.23 %) and class IV (2.01 %); in the 2 district: X (58.89 %), XII (6.09 %), XIII (5.01 %), I (4.61 %) and IV class (5.21 %); in the 3 district: X (66.29 %), XII (5.07 %), XI (3.94 %),

I (2.11 %) and IV class (1.62 %); in the 4 district: X (56.27 %), XII (5.91 %), XI (5.02 %), I (5.93 %), IV class (2.80 %); in the 5 district: X (64.63 %), XII (5.02 %), XI (4.02 %), I (4.02 %), III (2.14 %) and IV class (2.29 %), in the 6 district: X (59.81 %), XII (5.31 %), XI (5.11 %), I (3.86 %), III class (3.05 %), i.e. anemia (3.02%). It is noteworthy that distribution of rural children on separate districts in a structure of whole diseases has been shown the higher incidence for respiratory system, skin and subcutaneous tissue, digestive, musculoskeletal system, infectious and parasitic diseases, endocrine system, blood and hematopoiesis system, anemia – in the whole rural districts of the Dnepropetrovsk region.

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REHABILITATION PROGRAM FOR PATIENTS WITH ALGODYSTROPHY AFTER THE DISTAL RADIUS FRACTURE


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In this report we present a collaborative study performed by the physical-rehabilitation clinic and the rheumatology clinic at the University Hospital in Pleven, Bulgaria, regarding treatment of patients with algodystrophy syndrome after a distal radius fracture. 48 patients with algodystrophy syndrome after a distal radius fracture participated in the study. The complex therapy includes a drug treatment with calcitonin and a physiotherapeutic program: underwater gymnastics, kinesitherapy and electrotherapy using the magnetic field and interferential current. A positive effect from the complex drug and physiotherapeutic treatment has been achieved in all the observed indicators, regardless of the patients' age and sex.

Keywords: algodystrophy syndrome, distal radius fracture, physiotherapy, rehabilitation, occupational therapy.

Conference participant, National championship in scientific analytics

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Introduction

Algodystrophy syndrome is a term which encompasses a wide clinical specter and is closely related to posttraumatic reflex dystrophy, posttraumatic sympathetic dystrophy, algoneurodystrophy, shoulder-arm syndrome, osteoneurodystrophy and a causalgic syndrome (fig.1, 2) [3, 9].

Algodystrophy is thought to be caused by combining an exogenous factor (circulatory insufficiency or failure, swelling, painful and traumatic fracture repositioning, frequent repositions, poor bone ingrowth, etc), with a predisposing endogenous background (neuropsychological lability, hormonal imbalance, degenerative illnesses, high blood pressure, diabetes, etc.) [3, 5]. An X-ray scan reveals an ongoing spotty decalcification of the bone, most clearly visible around the fractures in the wrist area (fig. 3).

X-ray changes follow clinical

manifestations with a slight delay. The clinical process consists of three stages [3, 12] – acute inflammation, chronic inflammation and a dystrophy stage. Different treatments are proscribed depending on the stage of the illness – physiotherapeutic procedures [5], analgesics, vasodilators, neuroleptics, Calcitonin, intravenous regional sympathetic blockades, ganglionic block [8].

Aim

The aim of this study is to show the effect of a complex drug and rehabilitation program for treatment of patients with algodystrophy syndrome after a distal radius fracture.

Materials and Methods

The study is based on 106 patients with distal radius fracture, 48 of which have developed the M. Zudeck complication. The complex treatment therapy of patients with the complication includes drug treatment with Calcitonin

under the supervision of a rheumatology doctor and a physiotherapeutic program which is conducted every day for a period of 10 days, with 3-5 therapeutic courses over the course of 4-6 months. The program consists of [4]:

- Underwater gymnastics – a local bathtub with water at 34°C
- Kinesitherapy [8]
- Occupational therapy [1, 2, 10, 11]
- Low Frequency Magnetic Field (LFMF) – 15 – 20 min., 2 A, 1 – 100 Hz
- Interferential currents (IFC) – 5 min. 90 – 100 Hz ; 10 min. 1 – 100 Hz

All patients had initial and final measurements and tests taken according to a specifically created individual patient file, which includes: VAS test for the pain, goniometry, manual muscle test (MMT), hand grip test [4], and a daily activities life test (DAL) [6, 7].

Results

Algodystrophy patients endure a strong, "burning" pain (20 points),



Fig. 1

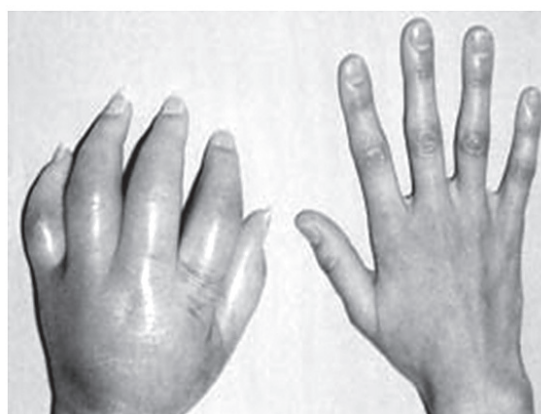


Fig. 2

Algodystrophy of fingers and wrist joint after distal radius fracture

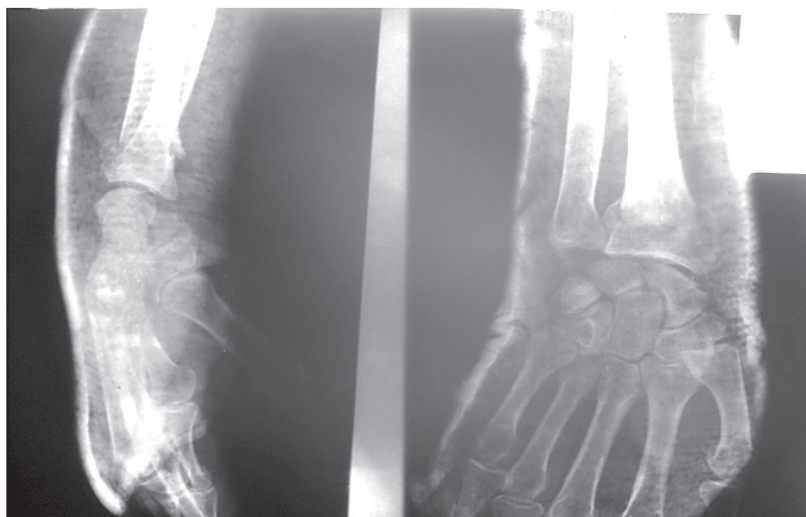


Fig. 3. Ro-graphy of a distal radius fracture

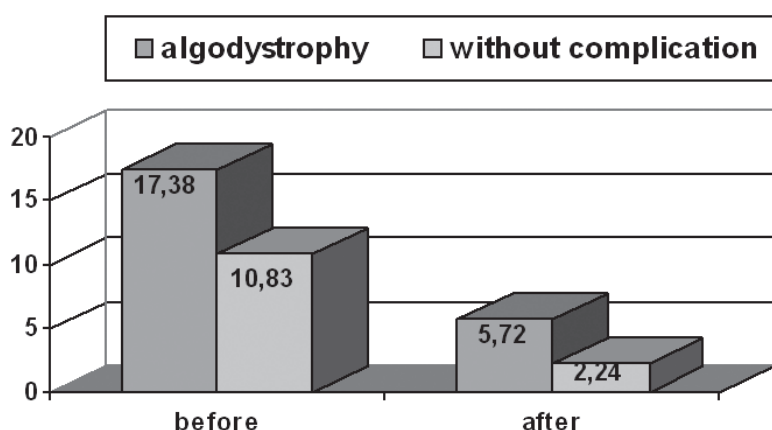


Fig. 4. Results of VAS for pain at the beginning and end of the recovery process (in points)

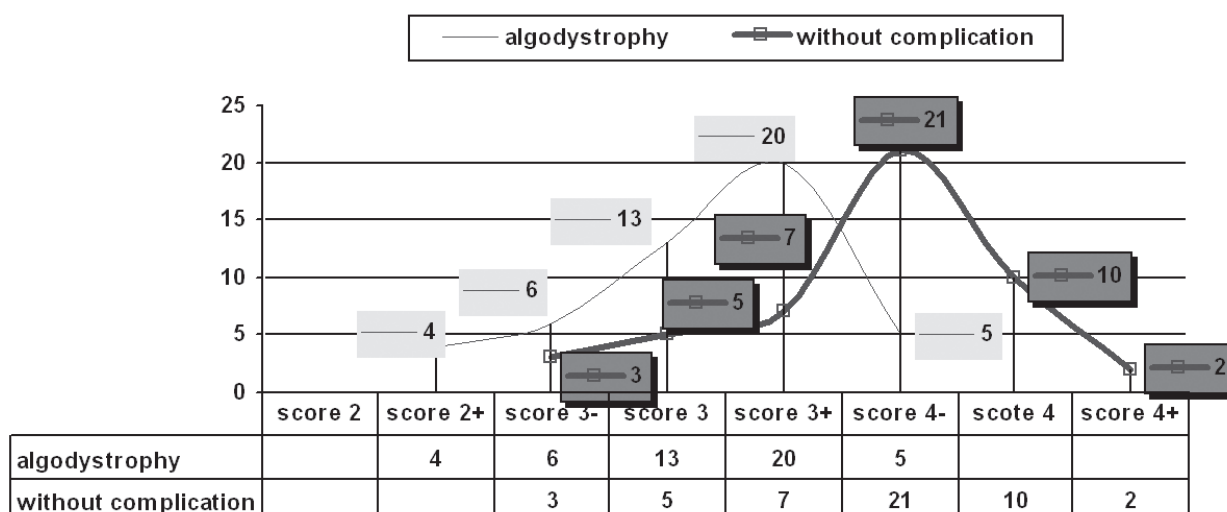


Fig. 5. Wilcoxon curve for restoring DAL at the end of the rehabilitation process

which frequently is consistent and unaffected by drug treatments. Figure 4 shows the results of VAS tests for pain, comparing the results of patients without complications with the results of patients who developed the algodystrophy syndrome. The median test result values at the beginning and end of the observed period were used for the comparison.

When measuring the joint movement volumes and the presence of an edema at the radio-ulnar and wrist joints and hypotrophy of the muscles of the forearm, the results were similar.

Figure 5 shows the Wilcoxon curves for restoring DAL abilities at the end of the rehabilitation process for patients with and without algodystrophy. The curve of patients without algodystrophy or complications is on the right, which indicates better rehabilitation results after a distal radius fracture. The results of the hand functionality and hand grip tests are similar.

Figure 6 presents the duration of the recovery period for patients with and without algodystrophy after a distal radius fracture. The data shows a significantly longer rehabilitation process for patients with M. Zudeck complication, as well as a longer immobilization period (measured in months) compared to patients without complications.

Implications

1. 42,45% of all patients included in the study developed algodystrophy,

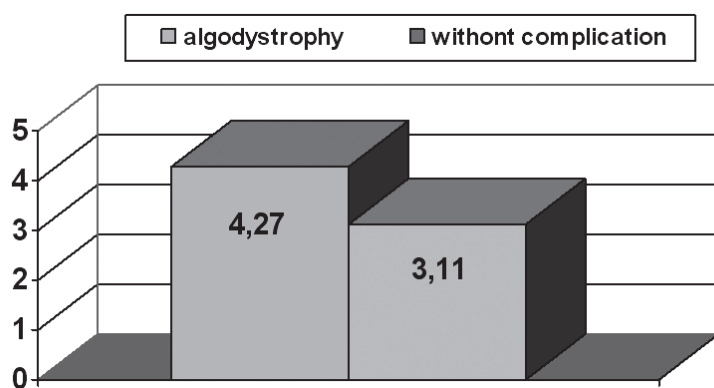


Fig. 6. Duration of the rehabilitation period for patients after distal radius fracture (measured in months)

which is a serious problem and requires a prolonged rehabilitation process and Calcitonin treatment.

2. The applied rehabilitation program has shown to significantly influence the rehabilitation process in a positive way for patients who have developed Zudeck's algodystrophy syndrome after a distal radius fracture.

3. When performing DAL activities, patients with Zudeck dystrophy face bigger difficulties, they recover more slowly and to a lesser extent than patients without the syndrome.

4. Analysis of the study results proves that a complex approach is required for treatment of posttraumatic conditions of the forearm for patients with algodystrophy syndrome.

Conclusions

The results and the clinical experience gained from the study give us reason to conclude that a positive effect from the complex drug and physiotherapy treatment is observed on all measured indicators for patients with Zudeck algodystrophy after a distal radius fracture, regardless of the patients' age or sex.

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REDUCING THE RISK OF DEVELOPMENT OF DISCRETE AND WAVE DEFORMATIONS ON THE TOOTH ENAMEL SURFACE

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The work is dedicated to the development of hypothesis of modeling the discrete-wave deformations in inhomogeneous structures of the tooth, allowing to identify patterns in development of micro-cracks and fissures of the tooth enamel in order to develop the prevention and treatment program.

Keywords: enamel cracks, deformation.

Conference participants


СНИЖЕНИЕ РИСКА РАЗВИТИЯ ДИСКРЕТНО-ВОЛНОВЫХ ДЕФОРМАЦИЙ НА ПОВЕРХНОСТИ ЭМАЛИ ЗУБА

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Работа посвящена разработке гипотезы моделирования дискретно-волновых деформаций в неоднородных структурах зуба, позволяющей выявить закономерности развития микротрещин и трещин эмали зуба с целью разработки лечебно-профилактической программы.

Ключевые слова: трещины эмали, деформирование.

Участники конференции

 <http://dx.doi.org/10.18007/gisap.msp.v0i9.1272>

Практика показывает, что если зубы реагируют на механические, температурные или химические воздействия, после санации полости рта, то, возможно, первопричина кроется в невидимых микротрещинах на поверхности эмали зуба. Однозначного ответа о природе и механизмах их появления медицинская наука пока дать не может, и соответственно разрабатываются различные методы диагностики и лечения, что вызывает большой интерес, как у исследователей, так и у клиницистов.

Цель данного исследования:

Моделирование дискретно-волновых деформаций, в неоднородных структурах зуба, выявить закономерность развития микротрещин и трещин эмали зуба и разработать лечебную программу при данной патологии.

Материалы и методы: метод системного подхода использовался для проведения количественного и качественного анализа, выявления существующих проблем в организации стоматологической помощи населению;

- клинические методы обследования для постановки диагноза;
- дополнительно проводилось рентгенологическое обследование;
- статистический метод применялся для определения уровня заболеваемости и показателей деятельности



Рис. 1. Макродефекты зубной эмали.

стоматологической помощи населению.

Обработка данных проводилась методами вариационной статистики с использованием стандартного офисного пакета MS Excel.

Результаты исследования и их обсуждение

Исследования зубов с дискретно-волновыми деформациями оценивали по результатам клинических осмотров 112 пациентов, у которых достоверно были выявлены макро и микро трещины, по средствам макросъемки и интраоральных исследований в раз-

личных вариантах преломления цвета.

Мы оценивали распространенность и интенсивность дискретно-волновых деформаций, определяли прирост макро и микро трещин, по данным повторных осмотров через полгода и год с фиксацией цифровых изображений и их компьютерного анализа с архивацией полученных данных (рис 1).

С точки зрения физики твердого тела, зуб человека представляет собой сложную неоднородную структуру, с различными физико-механическими характеристиками. Твёрдость зубной эмали определяется содержанием в ней кристаллов гидроксиапатита (до 75,04 %) и карбонатапатита (12,06 %),

и т.д., твёрдость достигает 391,6 кг/мм².

Гидроксиапатиты очень восприимчивы к кислотам и начинают заметно разрушаться при снижении pH < 4,5 и более. (pH слюны 5,6 - 7,6). При снижении биохимических показателей pH слюны, в группах наблюдений, выявлена закономерность, увеличение длины дефекта. Из приведенной таблицы видно, что при показателях pH слюны в одних и тех же группах максимальные значения отличаются с достоверной разницей 1,6 раза, в табл. 1.

Между стенками призм существует напряжение, которое и удерживает целостность зубной эмали при механической нагрузке. Межпризменное вещество эмали также состоит из кристаллов, как и призма, но они отличаются своей ориентацией. Однако даже в пределах одной из этих составляющих, можно говорить о структурной неоднородности, а значит, следует ожидать и изменения физико-механических характеристик эмали зуба при нагрузке.

На образование микротрещин влияют термодинамические изменения, дискретно-волновые деформации начинаются тогда, когда площадь дефекта начинает расти и со временем под влиянием различных факторов прогрессируют и достигают максимальных значений. Согласно молекулярно-кинетической теории, когда один из параметров, определяющий напряжение (состояние деформируемого тела) достигает предельного значения, тогда на поверхности эмали зарождается процесс трещинообразования, который в свою очередь вызывает гиперестезию, и соответственно запускается механизм выработки заместительного дентина. Данный механизм приводят к нарушению сбалансированной системы, и увеличению длины или площади дискретно-волновых деформаций.

Проведенные клинические обследования, засвидетельствовали, что более 21% пациентов, из числа осмотренных, имели дискретно-волновые деформации (трещины эмали) различных размеров. Установлено, что порядка 17,3 % из числа лиц, у которых выявлены дискретно-волновые деформации, отметили, что трещины зубной эмали они получили при травмах (в настоящей работе не уточнялась природа травма-

Часть обследованных с дискретно-волновыми деформациями при снижении pH

Возрастная группа	Из числа обследованных с ДВД				
	Число наблюдений	pH слюны 4,5	pH слюны 4,0	pH слюны 3,5	pH < 3,0
35–44 лет	37				
от 1 до 2 мм	14	6	4	3	1
от 2 до 3 мм	13	5	5	2	2
от 3 до 4 мм и более	10	2	2	2	4
45–54 лет	36				
от 1 до 2 мм	11	4	3	2	2
от 2 до 3 мм	12	2	2	4	4
от 3 до 4 мм и более	13	2	3	3	5
55-65 и старше	39				
от 1 до 2 мм	11	2	3	3	3
от 2 до 3 мм	13	3	2	4	4
от 3 до 4 мм и более	15	3	3	4	5

Табл. 1.

Часть обследованных с дискретно-волновыми деформациями, %

Возрастная группа	Из числа обследованных с ДВД				
	не имели	имели до 1 мм	имели от 1 до 2 мм	имели от 2 до 3 мм	имели от 3 до 4 мм и более
35–44 лет	86,3	5,4	3,8	2,6	1,9
45–54 лет	79,8	4,8	3,7	5,8	5,9
55-65 и старше	68,5	2,6	6,3	7,2	15,4
Всего	78,2	4,2	4,6	5,2	7,7

тического воздействия). Полученные данные приведены в табл. 2.

Из представленной таблицы следует, что с увеличением возрастного ценза в исследуемых подгруппах у пациентов с дискретно-волновыми деформациями, происходит увеличение длины дефектов, так подгруппе 55-65 лет и старше при длине дефекта 3-4 мм, отмечен максимальный показатель 15,4% в сравнении с подгруппой 35-44 лет, где этот показатель составил 1,9%. Такие данные, можно объяснить гидродинамическими процессами.

Для изучения механизма образования трещин была разработана и проведена экспериментальная часть работы, заключающаяся в исследовании

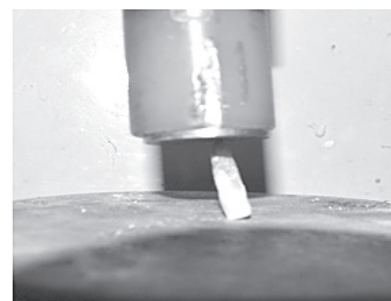


Рис. 2. Исследование зуба на одноосное сжатие в циклическом режиме.

особенностей деформирования свежесудаленных зубов. В экспериментальной части работы важным аспектом медицинской механики являлось опи-

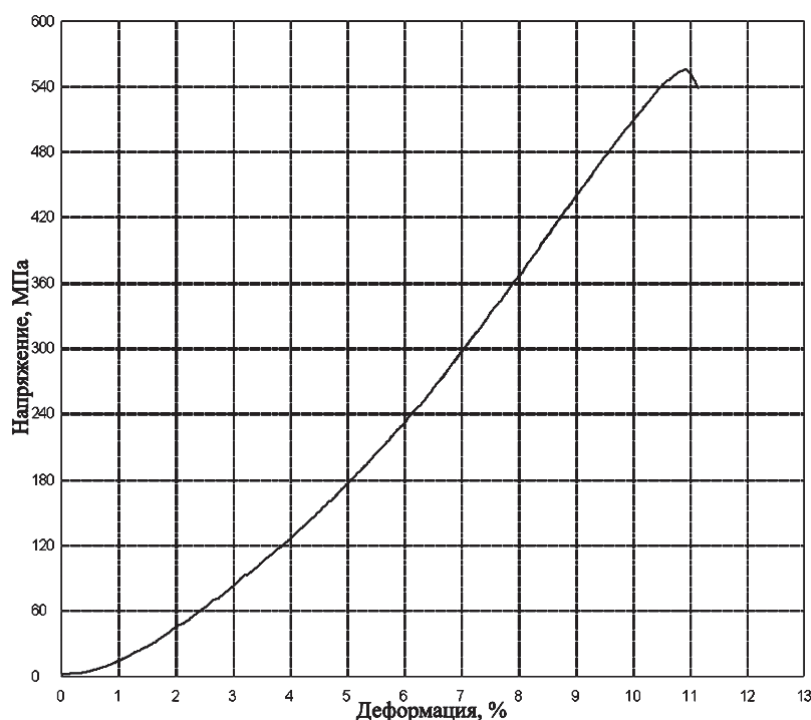


Рис. 3. Деформационная кривая при сжатии образцов

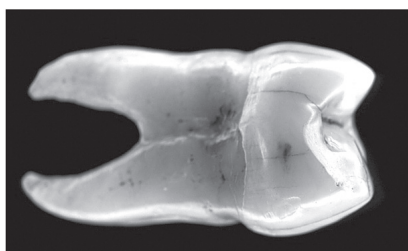


Рис. 4. Макротрещина коронковой части зуба.

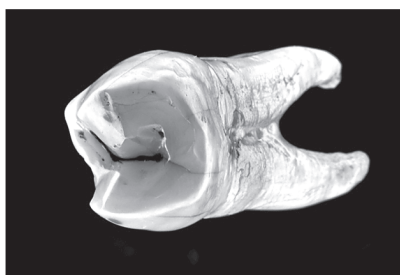


Рис. 5. Макротрещина коронковой части зуба.

сание контактных границ, для моделирования процессов разрушения эмали и целостности зуба. Мы использовали модели линейно-упругой среды и упругопластической с условиями пластичности сред (математические рас-

четы были представлены авторами в предыдущих работах).

В процессе функционирования зуб испытывает как внешние, так и внутренние нагрузки. Моделировались механические нагрузки на ось зуба в диапазоне от 50 до 450 кг/мм². На рис. 2 приведен фрагмент исследования зуба на одноосное сжатие в циклическом режиме.

Испытание на одноосное сжатие было проведено на 53 образцах (размеры ~ 2x2x0,65мм3, отношение d/h = 4,3). Испытания прекращали, когда на кривой наблюдался перелом. Изгибаясь по длине образца, они были во всех случаях ориентированы примерно под углом 45° к плоскости сжатия. Аттестация образцов эмали до и после сжатия показала, что после испытания они содержали большое количество трещин, но, несмотря на это распада образцов на части, как правило, не происходило, хотя в некоторых случаях от них отделялись довольно крупные фрагменты. Изгиб на деформационной кривой соответствовал зарождению в образце - линии перелома.

Типичная деформационная кривая сжатия для образцов из эмали приведена на рис. 3. Поэтому для эмали можно рассчитать, только предел прочности, соответствующий максимальному напряжению в процессе испытания, $\sigma_b = 538 \pm 87$ МПа и полную деформацию $\epsilon = 11,2 \pm 1,0\%$. По наклону касательной к верхней части кривой, был рассчитан тангенс (6,80 \pm 1,38 ГПа). Следовательно, можно сделать вывод, что образцы из эмали могут деформироваться, как упруго, так и в режиме пластической деформации. По величине упругой деформации был рассчитан предел упругости $\sigma_{упр} = 362 \pm 63$ МПа. Поэтому деформации и разрушения характеризуются не предельными напряжениями, а скоростью деформации, скоростью разрушения и временем до разрушения. При этом показатели надёжности могут быть представлены функциями физических характеристик, а также функциями скорости их изменения в зависимости от различных факторов.

После испытаний на циклическое нагружение (с использованием лабораторного пресса ЛП-03м) образцы всех групп зубов были подвергнуты механической нагрузке в диапазоне от 200 до 1000 кг/мм², в результате чего получены макродефекты рис.4-5.

Дискретно-волновые деформации, приводящие к образованию трещин, протекали в направлении от истонченной части эмали к режущему краю и жевательной поверхности зуба, где толщина эмали достигает максимальных значений. Решение системы матричных уравнений в среде MathCAD позволило получить следующие параметры, где максимальное образование микротрещин зафиксировано при нагрузках порядка 397,3 - 397,8 кг/мм², а лавинообразный рост микротрещин и переход в макротрещины отмечается при нагрузках от 398,4 - 399,2 кг/мм² и выше.

Предложенная модель развития трещин в эмали зуба подобна механизму развития трещины в автомобильном лобовом стекле типа «Триплекс». Такая аналогия не представляется корректной и требует более подроб-

Группа	Период	
	6 месяцев	12 месяцев
Основная	3 \pm 0,05	3 \pm 0,05
Контрольная	3,1 \pm 0,05	3,15 \pm 0,05

ного обоснования, например, прямого наблюдения пластической зоны перед вершиной магистральной трещины.

На основании проведенных исследований с целью предупреждения лавинообразного роста дискретно-волновых деформаций, была разработана методика лечения зубов с данной патологией.

1. Проведение профессиональной гигиены полости рта;

2. В районе вершины трещины на пике нагрузки, цилиндрическим бором который превышает ширину трещины, препарируется полость в пределах эмали или эмале-дентинной границы;

3. При необходимости наложить изоляционную прокладку;

4. Наложение фотокомпозитной пломбы (предварительно подобрав цвет);

5. Шлифовка полировка;

6. Электрофорез препаратов фтора (5-6 сеансов).

С целью оценки эффективности предложенной методики были проведены клинические исследования. С этой целью пациенты в подгруппе 45-54 года, у которых были диагностированы дискретно-волновые деформации (трещины) длиной 3 мм., были разбиты на две группы по 6 человек. В основной группе пациентам проводили предложенную методику, а в контрольной реминерализующую терапию. Оценку эффективности проводили посредством интраоральных исследований.

Результаты эффективности в основной группе зафиксировали стабилизацию процесса трещинообразования в контрольные сроки наблюдений. В контрольной группе динамический рост продолжался, несмотря на проводимую реминерализующую терапию.

Выводы:

Процесс деформирования твердого тела со сложной геометрией и неоднородным строением, каковыми несомненно являются зубы, представляет практический интерес для различных областей стоматологии и предполагает не только исследование деформационных процессов, инициированных импульсными нагрузками, но и моделирование циклических деформационных процес-


сов приводящих в конечном итоге и к частичному разрушению эмали. Важным аспектом моделирования является описание контактных границ, так как процессы деформирования формируют дискретно-волновую картину во всей области интегрирования. Лечение трещин по разработанной методике фотокомпозитными материалами, предотвращает образования макротрещин.

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CLINICAL EFFICACY OF INTRAOSSEOUS ANAESTHESIA IN TREATMENT OF DENTAL CARIES AND PULPITIS

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The efficacy of intraosseous anaesthesia in the treatment of dental caries and pulpitis was assessed. The author has determined the high efficiency of this method of pain relief in the treatment of the abovesaid pathology in the teeth of upper jaw and the front teeth of the lower jaw. In some cases, during the treatment of multirooted teeth on the lower jaw additional intraligamental anaesthesia is recommended.

Keywords: intraosseous anesthesia, intraseptal anesthesia, intraligamental anesthesia, caries, pulpitis.

Conference participant, National championship in scientific analytics,
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Foreword. The majority of dental procedures in patients are accompanied by pain of varying severity. Therefore, one of the main conditions for the successful treatment of dental diseases is effective pain relief. It creates favourable conditions for dental treatment, provides effective performance of techniques during the treatment, removes or reduces the severity of psycho-emotional stress of patients and the cardiovascular system reaction.

In dental clinics local anesthesia is commonly used for the purpose of anesthesia. It involves injecting and application methods. The widespread use of this kind of anesthesia in dentistry is conditioned by its relative safety and quick implementation [4].

In recent years, due to the introduction of new and improvement of the previously known methods of anesthesia in dentistry, not only the additional convenience for doctors and patients was reached, but also the safety of manipulation was improved [1].

Spongy anesthesia is a type of infiltration anesthesia, involving the introduction of a local anesthetic into the cancellous bone. It is divided into intraosseous, intraseptal and intraligamental [2].

In the available literature one can find data on the evaluation of the efficacy of intraseptal anesthesia in relation to dental procedures, but the available data is contradictory and does not take into account the teeth-group specificity.

The aim of this work is clinical evaluation of the efficacy of intraseptal anesthesia in the treatment of caries and pulpitis in the teeth of different groups and topographic specificity.

Materials and methods. Analysis of the efficacy of intraseptal anesthesia was performed in 90 patients during dental

treatment of teeth of all groups: incisors, canines, premolars, molars in the upper and lower jaws on caries (109 teeth) and pulpitis (124 teeth). Anesthesia was performed with carpool syringe needle of 0.3 mm diameter and 8 mm long. As an anesthetic the representative of the amide group (4% solution of articaine with epinephrine 1: 100000) was used. The needle was inserted into the base of the distal and medial papilla relative to the analgesic tooth, 2 mm below the top of the papilla on the lower jaw (above - on the upper jaw) in its centre, at the angle of 45° to the axis of the tooth. Reaching the interdental septum, 0.1 ml of solution was injected, cortical plate was perforated and another 0.2 ml of anesthetic was injected. Spongy anesthesia is, in fact, intravenous injection, so it comes almost "on the needle" (in 1-2 minutes) in contrast to traditional methods [5, 6]. Therefore, the treatment can be performed in 2 minutes after the anesthetic injection.

Analgesic effect was scored by painful sensations of the dental surgery patient. We did not use the point scoring proposed by the authors [4], because it is difficult to assess the effect of anesthesia subjectively by 30% or 70%. The efficacy of anesthesia was assessed using the following criteria: 1 point - complete pain relief; 2 points - tooth sensitivity during intervention; 3 points - painful manipulation. Treatment of dental caries and pulpitis, where the efficacy of intraseptal anesthesia corresponded to 1 and 2 points, was continued under the intraligamental anesthesia. Administering the anesthetic in the periodontal ligament through the circular gap of the tooth in an amount of 0.1-0.2 ml we reached the absolute anesthesia.

Statistical processing of the materials

was made on parametric criteria (mean value - M, standard error - m), significant differences between the performance of independent groups - by Student's T-test using the statistical software package AtteStat 10.8.4. for MS Excel. Differences were considered statistically significant at $p \leq 0,05$.

Study Findings and Discussion.

As can be seen from **Tables 1** and **2**, the average number of points indicating the efficacy of anesthesia has been decreasing from the front single-rooted teeth to the side multirooted teeth of both jaws. This relates both the treatment of teeth with caries and pulpitis. In single-rooted teeth of the upper and lower jaws the efficacy of intraseptal anesthesia reached 100%. In multi-rooted teeth the efficacy was a bit less; moreover it was lower in premolars and molars of the lower jaw than in the corresponding teeth of the upper jaw. This is due to the anatomical and topographical features of the alveolar bone of the jaws.

When detailing the efficacy of the studied method of anesthesia it was found out that in the treatment of caries in incisors and canines of the upper jaw 100% of the teeth multiroot. Among premolars the complete anesthesia was observed in 16 (94.1%) of 17 teeth, in 1 case (5.9%) the teeth preparation was sensitive. Upper jaw molars were cured in the absolute absence of pain in 12 (66.7%) of 18 teeth, the preparation was sensitive in 6 teeth (33.3%).

The efficacy of intraseptal anesthesia in the treatment of dental caries in the teeth of the lower jaw differed from the upper one; the quality of anesthesia was slightly lower, with the exception of incisors and canines (100% pain relief). So, in 14 (70.0%) of 20 premolars the anesthesia was complete, preparation of

4 teeth (20.0%) was accompanied by a pronounced sensitivity and 2 (10.0%) with pain. The treatment of molars was accompanied by even smaller efficacy of anesthesia. Complete anesthesia was registered only in 11 (57.9%) of 19 cases, 4 (21.1%) teeth were sensitive on the enamel-cement border and in the same number of teeth (21.1%) the anesthesia was not observed.

Pulpitis treatment under the intraseptal anesthesia, which consists not only of the tooth preparation, but also the removal of pulp, was less effective. Pulpectomy in incisors and canines of the upper jaw was done under complete anesthesia in 14 (93.3%) of 15 teeth; one tooth (6.7%) had sensitive pulp. Among premolar: in 21 (95.5%) of 22 cases the removal of the pulp was possible, in one case (4.5%) the increased nerve sensitivity was observed. In 16 molars (64.0%) of 25 the pulp extract from the root canals was not accompanied by pain, and in 9 (36.0%) cases after the opening of the pulp cavity in probing the patients reported a notable sensitivity.

Efficacy of the intraseptal anesthesia in the treatment of pulpitis in the teeth of the lower jaw was lower than in the teeth of the upper jaw. Thus, in the treatment of incisors and canines the pulp removal was painless in 17 (89.5%) of 19 teeth, in 2 (10.5%) teeth the preparation of the solid tissue was possible, but after pulp horn opening the patients reacted to probing. Pulpectomy of premolars was performed under the complete anesthesia at 11 (64.7%) of 17 teeth, the pulp in 4 (23.5) teeth was sensitive, in 2 (11.8%) teeth the response was not only to mechanical stimulation, but also to temperature. The least effective intraseptal anesthesia was marked at the treatment of pulpitis in molars. It was possible to open a horn of pulp and impose devitalizing means in 15 (57.8%) of 26 teeth, an increased sensitivity at the opening of the pulp chamber was noted in 5 (19.2%) cases, painful sounding of the bottom of carious cavity and pronounced response to thermal stimulant were recorded in 6 (23.1%) molars.

Additional intraligamental anesthesia provides fully painless manipulations in all teeth that used to have pain or sensitivity.

Thus, according to the results of

Table 1.
Efficacy of intraseptal anesthesia in the treatment of teeth of the upper jaw, points (M±m)

Pathology	Teeth-group specificity		
	incisors, canines	premolars	molars
Caries	3.0±0.0	2.9±0.06 P* > 0.05	2.7±0.1 P* = 0.004 P** = 0.04
Pulpitis	2.9±0.007	3.0±0.05 P* > 0.05	2.6±0.1 P* = 0.04 P** = 0.008

Note* - Statistically significant differences with the incisors and canines; ** - with the premolars.

Table 2.
Efficacy of intraseptal anesthesia in the treatment of teeth of the lower jaw, points (M±m)

Pathology	Teeth-group specificity		
	incisors, canines	premolars	molars
Caries	3.0±0.0	2.6±0.2 P* = 0.03	2.4±0.2 P* = 0.006 P** > 0.05
Pulpitis	2.9±0.07	2.5±0.2 P* = 0.05	2.3±0.2 P* = 0.01 P** > 0.05

Note* - Statistically significant differences with the incisors and canines; ** - with the premolars.

the study, the following **conclusions** can be made: intraseptal anesthesia in the treatment of caries and pulpitis has sufficient efficacy to carry out the necessary medical manipulations, especially for the treatment of all teeth in the upper jaw and in the front teeth of the lower jaw. In case of insufficient teeth analgesia, an extra intraligamental anesthesia provides the complete anesthesia.

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MODELING THE STRESS STATE OF HARD TISSUES OF A TOOTH IN THE PROCESS OF RESTORATION OF CLASS I CARIOUS CAVITIES

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To study the stress state of geometrically complex multilayered bio-mechanical system consisting of enamel, dentin and filling, the three-dimensional solid modeling in the SolidWorks software package and mathematical analysis with finite element methods in the ANSYS Workbench program were used in the research. In the mimicking, the tooth is seen as an elastically deformable body under static loading of evenly distributed force. It is found that the inner stress in the hard tissue of intact tooth is maximum (74.2 MPa) in the area of application of the load. The maximum stress (119 MPa) in a restored over the I class carious cavity tooth occurs in the area of enamel contact with the restoration.

Keywords: stress state, tooth, carious cavity, tooth restoration, dentine, enamel, finite elements method.

Conference participants, National championship in scientific analytics, Open European and Asian research analytics championship

 <http://dx.doi.org/10.18007/gisap.msp.v0i9.1266>

Foreword. Longevity of teeth restorations has important clinical and social importance. The development of secondary caries and restoration losses lead to the repeated visits of the patient to the dentist, and new preparation of hard tooth tissues. This can be a starting point for a number of morphological and functional changes not only in the teeth, but in the teeth-jaw system as a whole. This repeated machine treatment leads to thinning of hard tooth tissues, development of cracks and fractures. In the process of preparing and dental restoration, a number of problems, that impair the conditions for holding the restorative material in the carious cavity, can arise and this leads to reduction in the useful life of restorations [1]. One of these problems is secondary caries. Its appearance is possible at damage of marginal adaptation of fillings due to the properties of restorative material, polymerization stress, its contraction and elastic modulus [8, 13], as well as the carious cavity configuration factor [11].

Recently, experts have been increasingly focusing on the role of mechanical properties of dental tissues in high quality marginal adaptation of the material. Tooth tissues have a wide range of mechanical properties [10]. Even with high-quality preparation and restoration of cavities during the functional load in the tissues of the tooth own stress takes place, leading to cracks in dentin and enamel, damage of marginal seal, resorption and the loss of material [5]. Stress state of the hard tooth tissues was studied in detail during

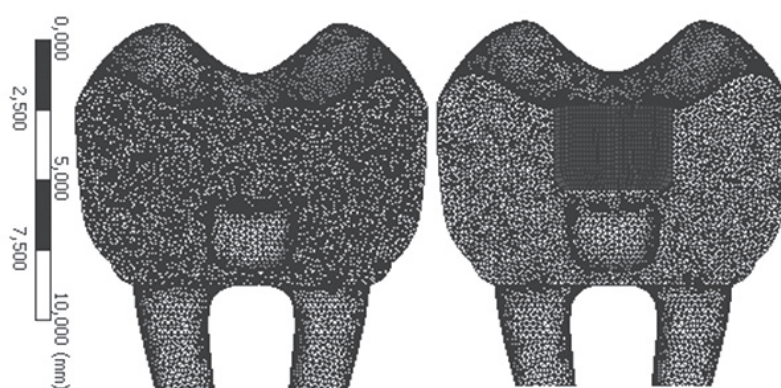


Fig. 1. The finite element model of the intact tooth and the restored one

the endodontic treatment [3], restoration of V-class cavities [7], recovery with artificial crowns [6], occlusal loads [9]. In accessible publications we have not encountered any information on the stress state in the tissues of the tooth, restored over the I class carious lesions.

The objective of our research is to study the stress in the tooth hard tissues using the computer modeling of the restored carious cavities of Class I that are prepared in a classical way.

Methods. A three dimensional model "Enamel – dentine – restoration" has been created on the basis of the X-ray image of the lower molar by means of the SolidWorks program; then it has been exported to the program complex ANSYS Workbench and the final element model has been formed (Fig. 1). The equivalent stress has been calculated by von-Mises upon condition that the root part of a tooth is accurately fixed, all components of the model are isotropic,

a vertical uniaxial charge is according to the tooth center 500 H.

Results. Under the influence of the vertical charge on the model in the intact tooth on the bite surface, the tensions in the enamel correspond topographically to the projection of fissures of molars (Fig. 2a). Several stress fields are identified there; they are spread concentrically from maximum values in the place of action of the charge to minimum values closer to the perimeter of fissures. The first field is formed in the place of action of the vertical charge, the maximum stress is 74.2 MPa. The second field is localized around the first one; it has lower values of the stress up to 50 MPa. The values of the third one decrease to 25-30 MPa. Isolated stress areas up to 35 MPa are determined in the zone of medial and distal edge. The fourth stress field possesses the lowest values – 10-20 MPa.

The character of the stress in the

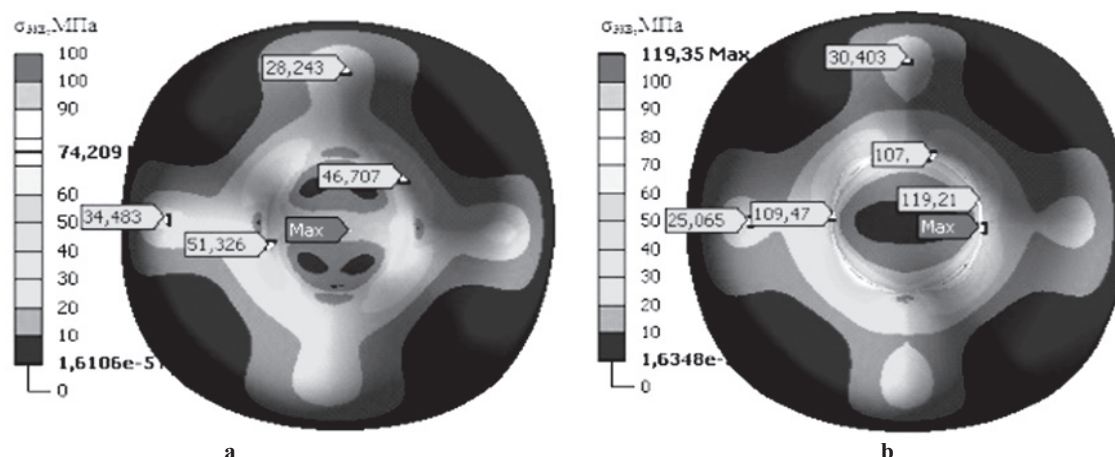


Fig. 2. Areas of stress in the enamel on the occlusal surface: intact tooth (a), restored one (b).

enamel in a restored tooth is the same as in the intact tooth (Fig. 2b). But the first field starts around the filling; the maximum stress value in the enamel is 119 MPa that is 60 % higher than in the intact tooth. The second stress field is about 100 MPa (100% higher than the intact one).

In the sagittal section of the intact tooth in the place of the charge the stress of the whole thickness of the enamel is 52-55 MPa, it reaches its maximum (74 MPa) in the area of enamel and dentine border. The values in the dentine decrease to 10 MPa. The same stress force is also determined in the neck area of the enamel and dentine (Fig. 3a).

In the restored tooth in the upper layers of the filling the stress created is same like in the enamel of the intact one (52-55 MPa). Moreover, in the area of the direct contact of the filling with the enamel, it is increasing almost up to 120 MPa. The stress force of hard tissues is decreasing to 10-15 MPa in the thickness of the cover dentine as well as in the neck area (Fig. 3b).

Discussion. Thus, the stress in the solid tissues of intact and restored teeth has different meanings. In the study we examined the components of the model “enamel-dentine-filling” as isotropic materials, but the physical properties of the tooth are uniform. Anisotropy of dentin ensures the availability of a tubular unit in its structure, and in enamel - prismatic structure [6]. The renewing material also has anisotropy due to non-organic filler. Thus, each component of the model “enamel-dentine-seal” has its own physical characteristics, especially elastic modulus. If this module in each component is different, the stress is distributing unevenly both upward and downward in them. Great tension arises in the element of the model, the elastic modulus of which is higher [2]. In our study it is shown that stress is much higher in the enamel, which is directly in contact with the filling material. It may be a risk factor for deformation in the enamel with the gradual weakening of its structure and development of micro-

cracks and defects leading to damage of marginal adaptation of restoration. Given this fact, it is necessary to use a recovery material which has an elastic modulus similar or close to the tooth - to strengthen their structure [12]. It is also necessary to carry out further research on methods used to optimize the formation of carious cavities, especially treatment of enamel margin.

Stress increasing in the enamel of the intact tooth on the enamel-dentine border can be explained by the peculiarities of the role of hard tissue with functional load and also higher elastic modulus in the enamel. Mechanical role of the enamel is to protect the dentine because of its high wear, and mechanical role of dentine is to absorb the power load because of its high strength resistance [4].

Stress state of a cervical part of intact and restored teeth is resulting from the transfer of reactive power from the surface of the load through the enamel-cementum junction to the root, and then

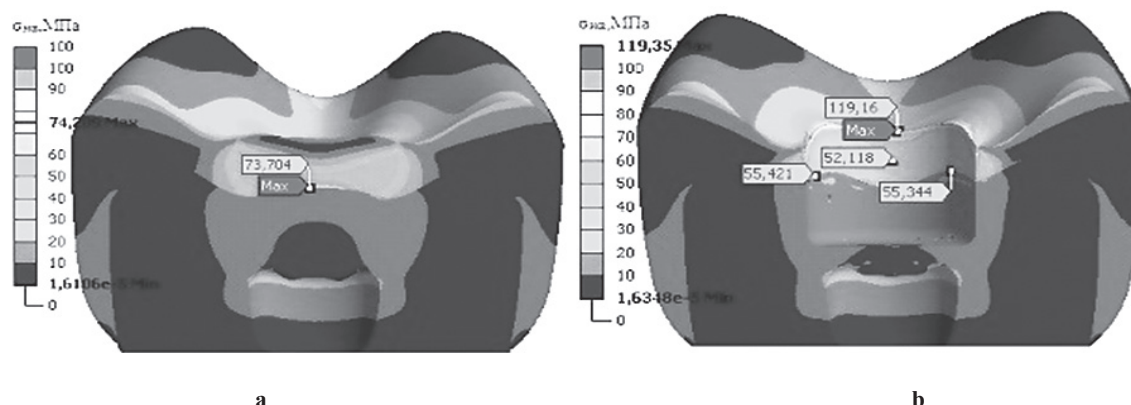


Fig. 3. Zones of stress of tooth tissues in the sagittal area: intact tooth (a), restored one (b).

in the alveolar bone. These forces can cause stress in remote areas from the standpoint of force application [7].

Conclusions. The stress in hard tissues of the intact and restored teeth has different values. Under the vertical uniaxial charge on the restored tooth, with decay of Class I of the molar of the lower jaw, the maximum stress appears on the border of the direct contact with the restoration.

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
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CONTRIBUTION OF PEROXIDE PROCESSES TO PATHOGENETIC MECHANISMS OF EXPERIMENTAL LIVER CIRRHOSIS

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The results of a series of experimental trials using rats with toxic liver cirrhosis are given. After 12 hours, and in 1, 3, 5 and 7 days after the pathological condition simulation, blood erythrocytes in animals as well as homogenates of liver parenchyma and pancreatic lipid peroxidation were determined by calculation of concentration of lipoperoxidation intermediates and the activity of antioxidant enzymes. The findings suggest that the course of experimental cirrhosis is accompanied by sharp intensification of lipid peroxidation and associated inhibition of the enzymatic activity and non-enzymatic antioxidant protection units, as noted in 5 days with a maximum severity on the day 3. There was shown the involvement of erythrocytes in mediating the pathological process, as well as the liver parenchyma and pancreas. The authors conclude that the complex pathogenetic therapy of liver cirrhosis should include the administration of preparations with expressed antioxidant properties.

Keywords: experimental cirrhosis, lipid peroxidation, antioxidant defence, blood, erythrocytes, liver, pancreas, complex pathogenetic therapy.

Conference participants, National championship in scientific analytics

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Treatment of patients with liver cirrhosis, liver failure and complications, as well as other inflammatory and fibrotic affections of the hepatic parenchyma, is an urgent problem of surgical gastroenterology [1-3]. In the age of significant technological advances that can considerably improve the efficacy of diagnosis and treatment (and also minimally invasive one) of the majority of human diseases including diseases of the gastro-hepatoduodenal area, morbidity and mortality of patients because of the diffuse liver disease (this is a broader category of diseases as to medical classification including cirrhosis and hepatic failure) tend to increase [4, 5].

Economic and social importance of this pathology should be noted in addition to medical, as besides high morbidity and mortality this liver pathology results in significant economic losses related to the financial and economic costs of treatment, rehabilitation, and maintenance treatment of this category of patients, as well as the working age of the patients - 30-40 years [6, 7]. A separate medical problem is the clinical progression of liver cirrhosis with signs of portal hypertension with the development of liver cancer, which is also a cause for concern for specialists. [8]

It can be noticed that this situation occurred in the field of biliary hepatology largely due to combination of insufficient notions on the pathogenetic mechanisms of liver failure and cirrhosis, as well as the lack of adequate effective schemes of complex determined pathogenetic

therapy of this pathology. Taking this into consideration and having long-term experience in surgical treatment and clinical follow-up of this group of patients, we started basic research in order to clarify the pathogenetic mechanisms of hepatocyte necrosis. Taking into account the systemic disturbances in the patients with liver cirrhosis, rapid development of hepatocellular insufficiency, as well as frequent development of multiple organ dysfunction syndrome with involvement of the pancreas, gall bladder, stomach, vascular component in the pathological process during this disease, we hypothesized the involvement of one of the typical pathological process, which was the inflammation in the pathogenesis of the disease under study [9, 10].

It is known that enhancement of lipid peroxidation is one of the body's response manifestations to the effect of the alternating factor that triggers a systemic inflammatory response. So, the purpose of the present study was to assess the intensity of lipid peroxidation in animals at experimental liver cirrhosis (ELC). An additional objective of the work was a comparative study of lipid peroxidation expression in the parenchyma of the liver and pancreas as well as peroxide disorders in the erythrocytes.

Materials and methods.

Experimental studies were carried out under the conditions of chronic experiment in 80 Wistar rat males weighing 250 to 320 g in accordance with the requirements established in national and international guidelines, rules and regulations on the use of laboratory

animals in experimental studies, as well as the requirements of the bioethics Commission of Odessa National Medical University.

The model of liver cirrhosis was reproduced in rats in toxic liver affection with hepatotropic poison - carbon tetrachloride, which had a direct cytolytic effect on the hepatic parenchyma [11]. CCl₄ solution was prepared from pure (99.99% purity) drug by adding refined sunflower oil (final solution concentration was 50%) and administered orally using a plastic probe two times a week during 10 weeks. Control animals (n = 9) were orally administered 0.5 mL of 0.9% NaCl saline in similar conditions. The control of ELC formation was performed by laparotomy with biopsy followed by histological examination of biopsy samples in the treated and control groups.

21 (26.3%) of 80 rats died from acute liver failure during the experiment. The remaining 59 rats were euthanized by overdose of etaminal sodium (100 mg/kg/ip) in 12 hours, and in 1, 3, 5 and 7 days after the formation of ELC. The animals' liver and pancreas were removed, a homogenate of the organ was prepared, after which the tissue samples were homogenised in the medium with 10 mM Tris-HCl buffer (pH = 7.4) at a ratio of 1: 9. In order to get solid fraction the homogenate has been centrifuged for 10 min at 3000 g (t = 0±2 ° C). The supernatant was used to determine the concentration of intermediate products of lipoperoxidation - malondialdehyde (MDA), diene conjugates (DC) - and the activity of antioxidant enzymes

Tab. 1.

**The concentration of lipid peroxidation products and antioxidant enzyme activity
in the blood of rats in different periods after reproduction of liver cirrhosis**

Indices under study	Control group, n=9	Values of the studied indices during different periods after reproduction of ELC (M±m), n = 10				
		in 12 hours	in 24 hours	on the 3 rd day	on the 5 th day	on the 7 th day
Malon dialdehyde, mcmol / l	1.41±0.11	2.69±0.18 ***	3.77±0.29 ***	4.41±0.37 ***	3.86±0.26 ***	2.27±0.23 **
Diene conjugates, mcmol / l	0.41±0.05	0.70±0.07 **	0.86±0.08 ***	0.97±0.11 ***	0.84±0.07 **	0.67±0.06 *
Catalase, cond. u	1.92±0.13	1.31±0.13 **	1.18±0.12 ***	1.08±0.10 ***	1.21±0.11 **	1.49±0.14 *
SOD units / ml	2.79±0.17	1.68±0.16 **	1.56±0.14 ***	1.48±0.13 ***	1.62±0.17 **	1.97±0.20 *
Total glutathione mM	20.1±0.6	15.7±1.1 *	15.1±1.0 **	14.4±1.2 **	15.6±1.3 *	16.6±1.3
a- tocopherol, (mcmol / ml)	51.8±3.7	38.9±3.8 *	35.9±3.5 **	33.4±3.3 **	36.2±3.7 *	37.3±3.6 *

Note: in all Tables * - $p < 0.05$, ** - $p < 0.01$, and *** - $p < 0.001$ - significant differences of the studied indices compared to those values in the control group (ANOVA statistical test)

- superoxide dismutase (SOD), glutathione peroxidase and glutathione reductase. The content of LP products was determined by the method described [12, 13]. SOD activity was determined by the level of NBT reduction inhibition in the presence of NADH and phenazine methosulfate. [14] Glutathione peroxidase activity was determined by the glutathione oxidation rate in the presence of tertiary butyl hydroperoxide [15], the activity of glutathione-NADRH – by the oxidized glutathione reduction rate in the presence of NADRH [16].

MDA and DC content in the rat blood plasma and red blood cells was determined as described [12, 13]. SOD

activity was determined by the method of [14]. Activity of general glutathione was determined by the method of [16]. The α -tocopherol content was determined as described [17] in the modification [18].

The results were processed statistically using One Way Analysis Of Variance Criteria. Differences were considered significant at $p < 0.5$.

Results and discussion.

There was a significant accumulation of MDA and DC in the blood of rats with ELC, absolute indices and concentrations of which reached 2.69 ± 0.18 nmol/l and 0.70 ± 0.07 mmol/l, respectively in 12 hours of the process, which was 1.9 times

($p < 0.01$) and 1.7-fold ($p < 0.1$) higher than in the control cases (Table 1). Later on, the value of MDA and DC continued to increase, reaching a maximum on the 3rd day of the pathological process when the value of the indices studied exceeded those in the controls by 3.1 times and 2.4 times (in both cases $p < 0.01$). Subsequently, there was a slight decrease in the value of MDA and DC, the concentration of which remained significantly higher than in controls ($p < 0.5$, Table 1) on the 7th day.

Under these conditions, the blood of rats showed a significant reduction in the activity of antioxidant enzymes - catalase, SOD, glutathione and

Tab. 2.

**The concentration of lipid peroxidation products and antioxidant enzyme activity
in the blood of rats in different periods after reproduction of liver cirrhosis**

Indices under study	Control group, n=9	Values of the studied indices during different periods after reproduction of ELC (M±m), n = 10				
		in 12 hours	in 24 hours	on the 3 rd day	on the 5 th day	on the 7 th day
Malon dialdehyde, mcmol / l	2.0±0.2	3.2±0.3 *	4.6±0.4 ***	4.9±0.5 ***	3.7±0.4 ***	3.3±0.4 **
Diene conjugates, mcmol / l	3.1±0.3	4.2±0.4 *	7.1±0.6 ***	7.6±0.7 ***	6.3±0.7 ***	4.6±0.4 *
Catalase, cond. u	2.9±0.2	2.0±0.2 *	1.6±0.2 **	1.3±0.2 ***	2.1±0.2 *	2.5±0.3
SOD units / ml	2.5±0.2	1.6±0.2 *	1.3±0.1 **	1.4±0.2 *	1.8±0.2 *	2.0±0.2
Glutathione peroxidase, mcmol/min/l	3.3±0.3	2.0±0.2 *	1.8±0.2 **	1.4±0.2 **	2.3±0.2	2.6±0.2
Glutathione reductase, mckat NADPH / l	1.4±0.1	0.9±0.1 *	0.7±0.1 **	0.8±0.1 **	1.0±0.1 *	1.2±0.1

Tab. 3.

The concentration of lipid peroxidation products and antioxidant enzyme activity in the blood of rats in different periods after reproduction of liver cirrhosis

Indices under study	Control group, n=9	Values of the studied indices during different periods after reproduction of ELC (M±m), n = 10				
		in 12 hours	in 24 hours	on the 3 rd day	on the 5 th day	on the 7 th day
Malon dialdehyde, mcmol / l	2.82±0.23	5.21±0.41 ***	6.43±0.51 ***	5.49±0.42 ***	4.87±0.31 ***	3.82±0.27
Diene conjugates, mcmol / l	0.41±0.06	0.94±0.09 ***	1.12±0.10 ***	1.06±0.10 ***	0.88±0.08 *	0.46±0.05
SOD units / ml	1.86±0.17	1.07±0.07 **	1.03±0.07 ***	1.00±0.06 ***	1.14±0.09 *	1.44±0.11
Glutathione peroxidase, units/g	2.56±0.21	1.34±0.13 **	1.21±0.11 ***	1.29±0.11 **	1.49±0.12 *	1.66±0.16
Glutathione reductase, units/g	2.66±0.13	1.62±0.14 **	1.32±0.11 ***	1.41±0.12 ***	1.78±0.14 *	2.19±0.17

□-tocopherol, indices of the absolute activity were minimal during 1 - 3 days since the moment of ELC reproduction ($p < 0.1$). Subsequently the activity of the studied enzymes did not restore until the 7th day of the experiment ($p < 0.5$, Table 1).

A concentration of the intermediate products of lipid peroxidation in the red blood cells had a similar tendency: intense pathobiochemical changes in the red blood cells were revealed during 1-5 days of the ELC course with the highest concentration of MDA and DC on the 3rd day of the pathological process, when the studied indices exceeded those in control cases in both cases ($p < 0.01$) by 2.5 times (Table 2). The activity of catalase, SOD, glutathione peroxidase and glutathione reductase in these conditions was maximally reduced on the third day of ELC ($p < 0.5$).

A course of ELC induced a significant

increase of MDA and DC concentration in the liver tissue, which was by 85% and 129% greater respectively already in 12 hrs after reproduction of the pathological state in comparison with those of control animals ($p < 0.01$, Table 3). The maximum expression of the intermediate products of lipid peroxidation accumulation was observed on the 1st day of ELC ($p < 0.01$) with a slight decrease in the studied indices on the 3rd ($p < 0.01$) and 5th ($p < 0.5$) days of the experiment. On the 7th day of the experiment the values of the studied indices did not differ in the experimental and control groups ($p > 0.5$).

Similar changes were registered in the reduction of activity, marked by the antioxidant enzymes in the red blood cells - SOD, glutathione peroxidase and glutathione reductase (Table 3).

The ELC course was accompanied by the increased concentrations of

MDA and DC and decreased activity of antioxidant enzymes investigated in the pancreatic parenchyma (Table 4). Maximum intensity of the changes marked was recorded after 24 hours from the moment of the ELC reproduction ($p < 0.01$) and has been observed for 3 days (with the exception of MDA concentration), later the studied indices were similar both in the experimental and control groups ($p > 0.5$).

Thus, our results after a critical analysis allow us formulate the following basic points concerning the pathophysiological mechanisms of ELC. First, the ELC course is accompanied by the increased lipid peroxidation manifested in the accumulation of intermediate products of lipid peroxidation and decreased enzymatic activity, and non-enzymatic antioxidant protection units. These facts are consistent with the known views

Tab. 4.

The concentration of lipid peroxidation products and antioxidant enzyme activity in the blood of rats in different periods after reproduction of liver cirrhosis

Indices under study	Control group, n=9	Values of the studied indices during different periods after reproduction of ELC (M±m), n = 10				
		in 12 hours	in 24 hours	on the 3 rd day	on the 5 th day	on the 7 th day
Malon dialdehyde, mcmol / l	2.87±0.19	4.82±0.33 ***	5.11±0.41 ***	4.59±0.29 **	3.61±0.21 *	3.14±0.23
Diene conjugates, mcmol / l	0.47±0.05	0.85±0.08 ***	0.92±0.08 ***	0.67±0.09 *	0.55±0.08	0.43±0.04
SOD units / ml	1.79±0.17	1.05±0.08 *	0.98±0.08 **	1.29±0.08 *	1.44±0.12	1.74±0.14
Glutathione peroxidase, units/g	2.71±0.19	1.47±0.12 **	1.31±0.11 ***	1.82±0.13 *	2.04±0.16	2.30±0.18
Glutathione reductase, units/g	2.59±0.14	1.67±0.12 **	1.43±0.12 ***	1.71±0.13 *	2.19±0.17	2.54±0.21

[19-21] on the pathogenetic role of intensification of lipid peroxidation in a number of pathological processes and inflammation under the action of heat, radiation factor and other alternating influences. Secondly, the data obtained demonstrates the involvement of the blood cell unit, namely erythrocytes, in pathogenetic mechanisms of the hepatocellular destruction; there is increased concentration of lipid peroxidation products and reduction of the antioxidant enzyme activity in the erythrocytes unidirectional with the blood plasma. Summing up these results and suggestions it becomes obvious that there is generalization of the pathological process in liver cirrhosis, which explains both its acceleration and magnitude of the abnormal cell changes, that should necessarily be taken into account in the clinical conditions when determining the appropriate treatment strategy for these patients.

Thirdly, we have shown the accompanying processes of accelerated lipid peroxidation and inhibition of antioxidant protection expression, which take place directly in the liver tissue. In our opinion this data explains the rapid development of large volume and, as a rule, irreversibility of the pathological process of the cellular destruction in liver cirrhosis. And finally, fourthly, taking into account the anatomical proximity, common physiological functioning and disorders similar to the liver parenchyma, which were manifested in shifting the dynamic equilibrium in the "POL-antioxidant system" towards the increased lipid peroxidation, we were able to clearly register the accumulation of lipid peroxidation products and inhibition of the antioxidant protection processes expression in the parenchyma of the pancreas somewhat less pronounced than in the liver tissue.

Summarizing the data, pathophysiological mechanisms of development of multiple organ dysfunction syndrome in liver cirrhosis, the development of liver fibrosis, portal hypertension and/or liver failure become obvious. Taking into account the facts of intensification of lipid peroxidation and resulted inhibition of antiradical protection activity, inclusion of drugs with antioxidant properties

facilitating and/or preventing the process of the hepatocellular destruction is important for making up schemes of complex pathogenetic reasonable pharmacotherapy of liver cirrhosis. It may also provide crucial protective effect in preventing the development of hepatic insufficiency.

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PREVENTION OF THE LIVER FAILURE DEVELOPMENT THROUGH DECOMPENSATION OF THE BILIARY SYSTEM IN PATIENTS WITH OBSTRUCTIVE JAUNDICE BY PERFORMING MINIMALLY INVASIVE LAPAROSCOPIC CHOLECYSTECTOMY

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The effectiveness of the two-step method of treatment of patients with mechanical jaundice (MJ) focusing on the liver functional state during the postoperative period was assessed. Endoscopic papillosphincterotomy (EPSP) was done in 98 (59.8%) patients, 88 cases of them (53.7%) were due to choledocholithiasis. EPSP was finished by lithoextraction in 59 patients (66.0%), by mechanical lithotripsy – in 29 patients (17.7%).

Laparoscopic cholecystectomy was done to all 98 patients 1-5 days after the EPST and to all patients in the 1st group. Surgical intervention was started laparoscopically; conversion was done in 25 patients. There were 6 cases of complications (5.9%) among the patients of 1st group which were eliminated during the postoperative period. All patients were alive at the time of 3 months after surgery. Clinical and laboratory checking confirmed the satisfactory level of liver functioning. Only 2 patients had transient hyperamylasemia. There were 12 cases (19.0%) of complications in patients of the 2nd group that was higher compared to the same index in the 1st group patients ($p < .01$). The clinical indexes of hepatic insufficiency development were present in 9 patients (14.3%) of the 2nd group that was also greater compared to group 1 ($p < .01$).

According to these data the authors recommend an individual approach to the selection of surgical treatment in each case, the operative interventions performed in the so-called "cold period", as well as obvious analysis of possible high operational and anaesthetic risk including the patient's age. The stages of surgical intervention in patients with obstructive jaundice and choledocholithiasis are the priority method of effective surgical treatment. The laparoscopic, but not open cholecystectomy performing at the second stage of treatment, prevents hepatic insufficiency formation in patients throughout the postoperative period.

Keywords: mechanical jaundice, laparoscopic cholecystectomy, open cholecystectomy, treatment stages, hepatic insufficiency.

Conference participants, National championship in scientific analytics

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Even over 25 years since the first laparoscopic cholecystectomy (LCE) performed by the French surgeon F. Dubois, its indications continue to expand [1, 2]. In this regard, it is important that endovideosurgical technologies and, in particular, laparoscopy have currently occupied positions in the selection of treatment tactics for surgical patients, and have also spread to the related specialties, giving them a new impetus to development [1, 3-6]. Surgery of organs of the hepatopancreatoduodenal area served as a source of evolutionary development of laparoscopic techniques, and LCE is officially recognized as the "gold standard" in the surgical treatment of the gallstone disease (GSD) [7, 8].

When analyzing the results of many years of clinical follow-ups and surgical treatment of patients with hepatic insufficiency (PI), we came to the conclusion that certain percentage of this disease develops due to ineffective treatment (objective or subjective causes) of patients with obstructive jaundice (OJ). We consider patients with OJ to be among those with acute surgical diseases, but we believe that urgent surgery is risky in obturation of the extrahepatic biliary tract, cholangitis and others with a

prospect of a significant number of complications - up to the formation of multiple organ failure and substantial (3.5 - 4-fold) growth in mortality, comparable with the corresponding figures in the conservative treatment of OJ [9-11].

The question of choosing the surgical treatment in this group of patients is controversial, but most experts believe that the two-stage method of treating such patients is the best. On the first stage, simultaneous or prolonged decompression, as well as sanation of the gallbladder or bile ducts are usually carried out. This allows eliminating the clinical manifestations of the disease (mainly of the inflammatory origin), and preparing the patient for performing the second, main stage of surgical treatment, aimed at elimination of the causes of OJ - performing LCE.

This tactic of treatment allows decreasing the number of postoperative complications, reducing the overall mortality and also providing prophylactic effect preventing the destructive changes in the liver parenchyma, the toxic effect of accumulation of bile acids in the hepatocytes and their necrosis.

Issues directly determining the treatment strategies for this category of patients by the surgeon are debatable.

There are different views as to what kind of pathology associated with the presence of OJ is to be considered essential in each case; what treatment should be started with; whether the clinical course of the disease allows to perform one-stage surgery, or it must be performed in sequence of several stages and what stages these should be; what surgical approach should be used in the treatment of patients with dysfunction of the cardiovascular and respiratory systems; what kind of surgery - laparoscopic or traditional [open] - should be performed for better postoperative course and prevention of development of multiple organ failure - this is a list of the most important questions, the answers to which should be fast, specific and individual in each case. They determine the tactics, scope and timeliness of surgery.

Objective.

Assessment of effectiveness of the two-stage method of treatment of OJ patients with a focus on improvement of the functional state of the liver in the postoperative period.

Materials and methods.

During the last 3 years we have treated 164 patients with OJ aged 32 to 72. There were 121 (73.8%) women and

43 (26.2%) men. The age of 85 patients (51.8%) was over 50, 56 patients (34.1%) were over 60 years old.

The diagnosis of OJ is based on clinical examination of patients, biochemical blood analysis, ultrasound examination of organs of the hepatopancreatoduodenal area, computed tomography, endoscopic retrograde cholangiopancreatography and percutaneous-transhepatic cholangiography.

Specific manifestations of the OJ syndrome including yellowness of the skin and sclera, were found in 138 (84.1%) patients, dark urine and feces acholia - in 69 (42.1%) patients, pain and feeling of heaviness in the right upper quadrant and in the upper abdomen - in 143 (87.2%) patients. 98 patients (59.8%) were found to have a dyspeptic syndrome (nausea, dryness or bitterness in the mouth, heartburn, belching, loss of appetite, changes in the stool character, etc.). Itchy skin with typical scratching on the body was noted in 32 (19%) patients and elevated body temperature - in 19 (11.6%).

As a result of treatment, all patients were retrospectively divided into 2 groups. A two-stage surgery with endoscopic papillosphincterotomy (EPST) at the first and LCE – at the second stage was provided to patients in the group 1 (n = 101, 61.6%). 63 patients (38.4%), expected to undergo a full open surgery for choledocholithiasis at the first stage and/or open cholecystectomy (OHE) at the second stage, constituted the group 2 for the investigation.

Monitoring of patients treated has been carried out during the first 7-10 days after surgery and 3 months after discharge.

The results obtained were processed statistically using One Way Analysis Of Variance Criteria. Differences were considered significant at $p < 0.5$.

Results and discussion.

Within the total number of patients with OJ the cause of obturation of the extrahepatic biliary tract was cholelithiasis and associated choledocholithiasis in 131 patients (79.9%), 17 patients (10.4%) had acute pancreatitis, the edematous form, 6 (3.7%) patients - a benign stricture

against the background of the common bile duct cholelithiasis, 5 (3.0%) patients - postcholecystectomy syndrome, choledocholithiasis, 3 patients (1.8%) - acute calculous cholecystitis, 2 patients (1.2%) - stenosis of the bile papilla.

EPST was performed in relation to 98 (59.8%) patients, 88 (53.7%) of whom were operated on for choledocholithiasis. We are active supporters of medical tactics in choledocholithiasis, despite the development of various methods of lithoextraction and lithotripsy. The arsenal of advanced tools for lithotripsy consists of hard and soft Dormia baskets and balloon catheters. We believe that it is advisable to apply hard baskets in cases when the diameter of the stone is comparable to the diameter of the terminal part of the common bile duct. Balloon catheters and soft baskets are useful for small stones, especially in floating calculi.

EPST was completed with lithoextraction in 59 patients (66.0%). Lithoextraction is indicated in patients with a burdened history when conduction of repeated control studies is undesirable, in high probability of stone impaction in the terminal part of the common bile duct in their spontaneous passage, and at presence of multitude of small stones. Lithoextraction is contraindicated in case when the calculus diameter is greater than the diameter of the terminal part of the common bile duct and size of the papillotomic orifice. Removal of stones was performed by Dormia basket Olympus, their number ranged from 1 to 11, the maximum diameter of the stone removed was 15 mm.

EPST with mechanical lithotripsy was performed in relation to 29 patients (17.7%). Mechanical lithotripsy was used in single calculi of over 10 mm in diameter in the narrow terminal part of the common bile duct, multiple stones in the hepaticocholedochus that fit tightly to each other, and in maintaining the sphincter apparatus of the big duodenal papilla in young patients.

Nasobiliary drainage for biliary decompression was performed to 7

(4.3%) patients, 3 patients (1.8%) - balloon dilatation and stenting.

Selection of the preoperative biliary decompression method was determined by the level of localization of the bile flow obturation; hence minimally invasive procedures are performed only for making an accurate diagnosis. We believe that effective treatment of this group of patients is possible only in case of the integrated use of the above-mentioned minimally invasive techniques.

We consider it appropriate to note here that the diagnostic search in patients with cholelithiasis complicated with choledocholithiasis, especially in the presence of OJ and cholangitis, is very limited in time. The surgeon has a few hours to make a decision. Selection of surgical tactics in relation to these patients is decisive, namely, in relation to which patients should the problem of elimination of bile hypertension and cholangitis be solved at the first stage, who should be provided with staged treatment, and who should receive direct surgery. We believe EPST to be effective operation aimed at correcting the disturbed bile outflow that allows us to recommend it as the operation to be chosen for patients with OJ in the obturation of the bile duct due to choledocholithiasis, and consider it to be the main method of surgical treatment for patients with OJ having a high degree of the operational risk.

LCE was performed to all 98 patients after EPST and all patients in the group 1 in 1-5 days. Surgery started laparoscopically. 25 patients had to be resorted to conversion. The cause for conversion in 12 of them was the presence of multiple stones of different diameters, which failed to be removed laparoscopically. 5 patients had cirrhosis of the liver; thereby significant blood loss developed while performing LCE. In 5 patients, the cause of conversion was intraoperative detection of Mirizzi syndrome with severe inflammation and presence of stones in the common bile duct, and in 3 cases there were indications to the formation of biliodigestive anastomosis - choledohjejunostomosis

All patients were clinically determined to have phlegmonous

gallbladder, which was confirmed by morphological examination. Bile hypertension and intervention on the major duodenal papilla is likely to cause inflammation of the bile duct, and especially of the gallbladder wall. It once again confirms our opinion of an individual approach to operations in the biliary system, especially in elderly patients.

6 cases of complications (5.9%) were observed among the patients in the group 1, which were eliminated during the postoperative period, before discharge of the patients. All patients were still alive after 3 month follow-up after surgery. At this time, clinical and laboratory indices confirmed a satisfactory degree of the liver functioning, which was confirmed by its ultrasonography. Only 2 patients had transient hyperamylasemia.

Significantly more postoperative complications - in 12 patients (19.0%) were observed among patients in the group 2 compared to the index in the patients of the group 1 ($p < 0.1$). At the time of examination in 3 months after the operation 3 patients died because of liver failure. According to medical history, as well as the clinical and laboratory examination methods, the development of liver failure in patients in the group 2 was observed in 9 patients (14.3%), which significantly exceeded this figure in the patients of the group 1 ($p < 0.1$).

Thus, the data obtained allows us formulate the main conceptual approaches to the tactics of minimally invasive surgical treatment of patients if they have OJ syndrome due to bile duct obturation.

We consider it important to recommend avoiding surgical interventions at the "height" of the inflammatory period, in a maximum clinical severity of jaundice. Secondly, we note the necessity to operate on such patients in the so-called "cold" period. Thirdly, an individual approach must be an obligatory factor in choosing the tactics of the surgeon who should take into account the medical history of patients, clinical peculiarities of the disease, data from laboratory blood tests, results of preoperative diagnostic procedures, presence of concomitant medical conditions, possible high

operational risk, the functional state of the cardiovascular and respiratory systems, etc.


Fourthly, in the presence of biliary decompression a question should be solved of one-, two- or three-stage tactics of treatment of such patients. According to our data, two-stage treatment of patients with OJ is successful in the presence of choledocholithiasis, when EPST is performed at the first stage to reduce hypertension and biliary elimination of biliary decompression, and LCE performance – at the second stage.

In addition, we want to single out the aspect of the liver functioning in the postoperative period, because our data convinces that in OJ patients LCE, but not OCE is a prophylactic measure preventing the liver failure development. It is also important that patients with obstructive jaundice and choledocholithiasis in the presence of pathology of the cardiovascular and respiratory systems as well as patients over 60 are advisable to perform a three-stage surgery.


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ENDOSCOPIC TREATMENT OF URETHRAL OBLITERATIONS

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High efficiency of endoscopic surgeries of urethral obliterations allowed expanding the indications for their application. As a result a number of complications that can emerge due to these interventions have grown. Types of these interventions, as well as their causes, the diagnostic methods and treatment processes must be studied.

In this study the results of 112 endoscopic interventions in patients with urethral obliterations of various aetiology have been examined.

The early satisfactory results of urethrotomy confirm the efficacy on the level of 85.7%. A general result of efficacy of endoscopic treatment of urethra obliteration after 2 years of post-operatively treatment is shown by 106 (94.6%) patients and unsatisfactory – by 6 (5.3%) patients.

Adequate selection of methods of the urethra obliteration treatment largely depends on the characteristics of the disease: etiology, localization and extent of obliteration. Despite this, the surgical treatment of extensive structures and urethral obliteration requires an individual approach.

Keywords: endoscopy, quality of life, urethrotomy, urethra, urethral stricture, urethral perforation.

Conference participant, National championship in scientific analytics,
Open European and Asian research analytics championship

ЭНДОСКОПИЧЕСКОЕ ЛЕЧЕНИЕ ОБЛИТЕРАЦИЙ УРЕТРЫ

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Высокая эффективность эндоскопических операций при облитерациях уретры позволили расширить показания к их применению. В результате возросло и количество осложнений, которые могут возникнуть вследствие этих операций, виды которых, причины их возникновения, методы диагностики и способы лечения необходимо изучить.


В данном обзоре были исследованы результаты 112 эндоскопических операций, проведенных пациентам с облитерациями уретры различной этиологии.

Ранние удовлетворительные результаты уретротомии подтверждают эффективность на уровне 85,7%. Общий результат эффективности эндоскопического лечения облитерации уретры после 2-х лет послеоперационного лечения отмечен у 106 (94,6%) пациентов, и неудовлетворительный – у 6 (5,3%) пациентов.

Адекватный выбор метода лечения облитерации уретры в значительной степени зависит от характеристик заболевания: этиологии, локализации и протяженности стриктуры. Несмотря на это, хирургическое лечение обширных стриктур и облитерации уретры требует индивидуального подхода.

Ключевые слова: эндоскопия, качество жизни, уретротомия, уретра, перфорация уретры.

Участник конференции, Национального первенства по научной аналитике,
Открытого Европейско-Азиатского первенства по научной аналитике

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Быстрое развитие эндоурологии позволило использовать трансуретральные эндоскопические методы в диагностике и лечении большинства урологических заболеваний нижних мочевыводящих путей. Прежде всего, это относится к стриктурам уретры [1,2]. Высокая эффективность и низкая травматичность внутренней оптической уретротомии, возможность повтора операции без существенного риска для больного и органа позволили расширить показания к ее применению и, в ряде случаев, сделать ее методом выбора при лечении больных со стриктурами уретры [3].

Прибегая к трансуретральным эндоурологическим операциям, уролог должен хорошо знать, что и при таких хирургических вмешательствах могут возникнуть различные осложнения технического или клинического характера [4,6].

Техника трансуретральных операций обуславливает использование уретры в качестве доступа, что накладывает ограничения и вызывает потенциальную опасность возникновения разных осложнений при выполнении этих операций, особенно при наличии сопутствующих заболева-

ний. Ограниченный доступ затрудняет диагностику и лечение возникающих осложнений и выводит на первый план их профилактику [4].

Сегодня существует небольшое количество публикаций по вопросам, связанным с осложнениями эндоскопических операций на уретре и способом их ликвидации, поэтому в данной работе нами проанализированы случаи возникновения осложнений и неудач в процессе выполнения хирургических операций на уретре [5,6].

Материалы и методы. Было выполнено 112 эндоскопических операций в отделении Эндоурологии Республиканской клинической больницы по поводу облитерации уретры в период 2000-2010 гг. Все наблюдаемые пациенты были мужского пола, носителями предварительной цистостомы, в возрасте от 34 до 78 лет. Сроки наблюдения составляли 2 года. Диагноз облитерация уретры был поставлен в ходе клинического, параклинического и рентгенологического исследования, послеоперационно была проведена оценка по Международной системе суммарной оценки симптомов при заболеваниях простаты IPSS и оценка по Международной системе качества

жизни (QoL). Были собраны данные анамнеза (причина возникновения и срок существования облитерации, перенесенные операции, сопутствующие заболевания). Помимо общеклинических методов осмотра, пациентам с облитерациями уретры были проведены исследования (ретроградная уретроцистография, цистография, УЗИ губчатого тела, послеоперационно – урофлоуметрия, определение остаточной мочи), с целью уточнения локализации и протяженности стриктуры, а также состояния парауретральных тканей в соответствующем отделе. При оценке лабораторных данных особое внимание было уделено определению наличия инфекции мочевыводящих путей, как одному из факторов, способных осложнить течение послеоперационного периода. На основе проведенного обследования, все пациенты были распределены исходя из локализации и этиологии облитерации уретры.

По результатам распределения пациентов по происхождению и локализации облитерации уретры мы получили следующие результаты. Из 112 пациентов (п.), у 29 п. (25,8%) наблюдались послеоперационные об-

литерации, возникшие после различных операций на уретре: открытых (10 п.), эндоскопических (19 п.) и у 83 п. (74,1%) - были облитерации уретры различной этиологии. У 52 п. (46,4%) причиной стриктуры уретры было ее травматическое повреждение. У данных больных в анамнезе имелись отметки о перенесенных в прошлом травмах таза и промежности, а у 23 п. (20,5%) причины заключались в специфических или неспецифических воспалительных процессах мочеполювой системы. У 8 п. (7,1%) невозможно было точно определить причину возникновения облитерации уретры (длительная или неоднократная катетеризация, расширение методом дилатации, цистоскопия). Анамнез данной категории больных не содержит данных о перенесенных операциях на уретре, венерических заболеваниях или травме. В большинстве случаев облитерации располагались в мембранозном отделе уретры, а их протяженность составляла 1,5-2,5 см.

Во всех 112 операциях была выполнена внутренняя оптическая уретротомия «холодным ножом», дополненная уретротомией OTIS в 16 (14,2%) и внутри оперативном механическим чреспузырным расширением (методом бужирования) в 12 (10,7%) случаях. В 6 (5,3%) случаях операция дополнялась трансуретральной резекцией рубцовых тканей. Операции проводились под внутривенной анестезией – 62%, и в 38% случаев – под спинномозговой анестезией. Только у 13 п. (11,6%) эндоскопическая коррективировка облитерации была выполнена параллельно эндоскопическим операциям на мочевыводящих путях, таким как: трансуретральная резекция про-

статы или шейки мочевого пузыря, механическая цистолитотрипсия и т.д.

Время выполнения операции обычно не превышало 15-30 минут. После завершения операции, уретра шунтировалась уретральным катетером различного диаметра. Время шунтирования и размер катетера определялись видом операции, наличием внутри операционных осложнений, сроками послеоперационного дренирования мочевого пузыря. При выполнении внутренней уретротомии чаще всего – в 90% операций – устанавливались катетеры на 18 и 20 Fr. Сроки дренирования мочевого пузыря колебались от 8 до 14 дней. На 6-й день уретральный катетер был удален у 23 (20,5%) пациентов, на 10-й день – у 3 п. (2,6%) – у всех причиной были лихорадочные состояния. Цистостомический дренаж был устранен на 2-3-й день после операции у всех пациентов. Результаты. Удовлетворительные ранние результаты лечения после выполнения уретротомии (снижение показателя IPSS ниже 8 баллов, снижение показателя QoL ниже 3, увеличение максимальной скорости мочеиспускания выше 15 мл/с, объем остаточной мочи ниже 20 мл) были отмечены у 96 п. (85,7%). 16 п. (14,2%) наблюдались путем механических расширений в течение одного года. Рецидив стриктуры в течение двух лет после операции был отмечен у 6 больных (5,3%), из которых 4 были повторно прооперированы эндоскопически, и только один – путем открытой классической операцией. Таким образом, общий анализ эффективности эндоскопического лечения стриктуры уретры через 2 года после операции был отмечен у 106 (94,6%) больных. При проведении

112 операций был установлен ряд осложнений. Данные о частоте осложнений в различные периоды и методах их ликвидации представлены в таб. 1.

Наиболее частыми внутри операционными осложнениями эндоскопических операций были: образование «ложного хода», перфорация уретры и кавернозные кровотечения. Эти осложнения были отмечены, соответственно, у 28 (25%), 13 (11,6%) и 26 (23,2%) больных. Нами были установлены причины возникновения данных осложнений: введение инструмента с усилием без надлежащего зрительного контроля, а способствующими факторами был небольшой опыт выполнения данных операций; несоблюдение техники выполнения операции, рассечение следует выполнять только после введения направляющей (струны или уретрального катетера) до мочевого пузыря; наличие облитерации уретры, за которой следует очень протяженная стриктура, которая не позволяет ввести через нее направляющую струну или уретральный катетер. При возникновении данных осложнений необходимо срочное вмешательство по восстановлению просвета уретры, в противном случае операцию следует завершить повторным установлением цистостомического дренажа.

Достаточно часто при выполнении внутренней оптической уретротомии происходила экстравазация ирригационной жидкости. Это осложнение легко выявляется во время осмотра, когда соответствующие ткани резко увеличиваются в размерах. В случае отсутствия значительной перфорации уретры, это осложнение купируется консервативными мероприятиями. Перфорация уретры с последующим

Табл. 1.

Осложнения трансуретральных эндоскопических операций при облитерациях уретры.

Осложнения	Внутри-операционные		Ранние послеоперационные		Отдаленные послеоперационные	
	Кол-во	%	Кол-во	%	Кол-во	%
«Ложные ходы»	28	25%	-	-	-	-
Перфорации	13	11,6%	-	-	-	-
Кровотечения	26	23,2%	3	2,6%	-	-
Уретриты	-	-	14	12,5%	9	8,0%
Орхоэпидимиты	-	-	5	4,4%	3	2,6%
Повторные цистостомии	6	5,3%	1	0,89%	-	-
ТУР-синдром	-	-	0	-	-	-
Летальный исход	-	-	1	0,89%	-	-

скоплением ирригационной жидкости – достаточно тяжелое осложнение, в связи с дальнейшим развитием фиброматозного процесса в парауретральных тканях и образованием более сложного сужения уретры, что крайне неблагоприятно для дальнейшего лечения пациента [1,6]. Среди 28 (25%) случаев образования «ложного хода» и 13 (11,6%) случаев перфорации уретры, в 14 (12,5%) случаев отдаленно отмечен рецидив стриктуры, из них 6 (5,3%) были оперированы повторно, и 8 пациентов получали амбулаторное лечение путем механического расширения. Следует отметить, что такие осложнения, как образование «ложного хода» и перфорации отмечались внутриоперационно чаще всего (31 случай) у больных со стриктурами посттравматической этиологии. В зоне сужения кровоснабжение и иннервация тканей значительно нарушены, что ведет к скоплению ирригационной жидкости в окружающей ткани.

В условиях данного механизма образования стриктуры в целом наблюдаются более жесткие изменения тканей, парауретральные процессы рубцевания более выражены, а эндоскопические ориентиры менее выражены, что определяет более высокую вероятность развития перфорации уретры [2,3,5]. Кровотечение из кавернозных тел в виде внутриоперационного осложнения отмечалась у 26 (23,2%) п., и послеоперационно – у 3 п. (2,6%) Это наблюдалось при наличии облитераций, за которыми следовали протяженные стриктуры (до 2,5 см) пенального и бульбозного отделов уретры. Данное осложнение является последствием рассечения рубцов до здоровых тканей губчатого тела, то есть уретрорагия отмечается в случае любого хирургического вмешательства, правильно выполненного с технической точки зрения.

Среди воспалительных осложнений уретротомии можно отметить уретрит и орхоэпидидимит. Острый уретрит был отмечен у 14 (12,5%) больных в раннем послеоперационном периоде и в 9 (8,0%) случаях послеоперационно отдаленно, острый эпидидимо-орхит – у 8 больных (7,1%), то есть у 5 п. (4,4%) в раннем послеоперационном периоде и у 3 п.

(2,7%) послеоперационно отдаленно. Основные причины развития этих осложнений – наличие до операции инфекции мочевыводящих путей и присутствие цистостомического дренажа. С другой стороны, частота развития воспалительных осложнений является показателем наличия внутрибольничной инфекции и эффективности мер асептики и антисептики. Но при развитии таких внутриоперационных осложнений, как кровотечение и перфорация уретры с экстравазацией ирригационной жидкости, вероятность развития воспалительных осложнений значительно возрастает [3].

Осложнение в виде воспаления уретры эффективно лечится с помощью консервативной терапии. Несмотря на это, сохранение уретрита ведет к развитию выраженного воспаления в прооперированной области, что вызывает образование существенного фиброза и рецидив стриктуры. Послеоперационный уретрит, вызывающий лихорадочное состояние и интоксикацию, требует раннего устранения уретрального катетера, что также может быть причиной неэффективности операции [2,5].

Нами установлено, что частота развития уретрита прямо пропорционально зависит и от калибра уретрального катетера. Считается, что использование уретрального катетера калибра не более 18 Fr у взрослого мужчины не вызывает существенных нарушений трофики уретры и не ведет к развитию уретрита. Применение уретрального катетера размерами 20-24 Fr вызывает расширение стенок уретры, нарушение кровообращения в слизистой уретральной стенки и развитие уретрита, в итоге образуется существенный парауретральный фиброз. При возникновении острого орхоэпидидимита проводят консервативное лечение. Частота возникновения острого орхоэпидидимита не зависит от локализации и протяженности стриктуры или от продолжительности операции, а зависит, по мнению большинства авторов [1,2,4], от патогенности инфекции, степени снижения гуморального и клеточного иммунитета, наличия факторов, поддерживающих развитие воспалительного процесса (скопление жидкости,

уретрорагия, и т.д.).


Мы проанализировали основные закономерности развития воспалительных осложнений после трансуретральных эндоскопических операций на уретре. Именно наличие цистостомы было одним из важнейших факторов, способствующих развитию воспалительных осложнений после операций на уретре. Так, из 112 случаев эндоскопического лечения, в 27 (24,1%) случаях у пациентов были воспалительные осложнения из-за наличия предварительного цистостомического дренажа.

Выводы. Ранние положительные результаты наблюдения внутренней уретротомии использованной при облитерации уретры подтверждают эффективность на уровне 85,7% а общая эффективность данной операции, включая и отдаленные (24 мес.) результаты, составляет 94,6%. Адекватный выбор метода лечения облитерации уретры в значительной степени зависит от характеристик заболевания: этиологии, локализации и протяженности стриктуры. Эндоскопическое лечение облитерации уретры показано при стриктурах протяженностью до 2,5 см, локализующихся в бульбозном, мембранозном или простатическом отделе уретры. Эндоскопическая операция при облитерации уретры небольших размеров является эффективной, щадящей и служит альтернативой открытым хирургическим операциям. Несмотря на это, хирургическое лечение обширных стриктур и облитерации уретры требует индивидуального подхода.


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DEVELOPMENT AND VALIDATION OF THE SPECTROPHOTOMETRIC TECHNIQUE OF THE PEROXIDE REMAINS DETECTION IN WASHING WATERS WHEN CONTROLLING THE QUALITY OF SANITARY PROCESSING OF EQUIPMENT

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The authors have developed and validated the method for detection of residual amounts of hydrogen peroxide using the triiodide spectrophotometric method at the level of 10 ppm in the washing water of technological equipment used for pharmaceutical production of 2% Lidocaine solution for injections.

Keywords: Hydrogen peroxide, residual, spectrophotometry, triiodide ion, determination, washing water.

Conference participants


РАЗРАБОТКА И ВАЛИДАЦИЯ СПЕКТРОФОТОМЕТРИЧЕСКОЙ МЕТОДИКИ ОПРЕДЕЛЕНИЯ ОСТАТКОВ ПЕРОКСИДА ВОДОРОДА В ПРОМЫВНЫХ ВОДАХ ПРИ КОНТРОЛЕ КАЧЕСТВА САНИТАРНОЙ ОБРАБОТКИ ОБОРУДОВАНИЯ

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Разработана и провалидирована методика определения трийодидным спектрофотометрическим методом остаточных количеств пероксида водорода на уровне 10 ppm в промывных водах технологического оборудования фармацевтического производства лидокаина раствора для инъекций 2%.

Ключевые слова: пероксид водорода, остатки, спектрофотометрия, трийодид-ион, определение, промывные воды

Участники конференции

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Введение. В настоящее время пероксид водорода (ПВ) находит широкое применение в пищевой и фармацевтической отраслях промышленности для дезинфекции воды и санитарной обработки оборудования [1]. В связи с этим возникает необходимость контроля содержания ПВ в последней порции промывной воды. В научной литературе описаны различные аналитические методики определения следовых количеств ПВ в водных растворах с использованием высокочувствительных методов хемилюминесценции [2], флуоресценции [3], электрохимии [5-6], спектрофотометрии [7-9], а также различных тест-систем [10-12] и др. [13-15]. Однако известные методики в основном длительны, требуют дорогостоящих реагентов и зачастую сложного оборудования. Относительно дешевыми, быстрыми и простыми в выполнении, а также достаточно чувствительными являются спектрофотометрические методики. Так, в ранних работах описано несколько заслуживающих внимание методик непрямого спектрофотометрического определения ПВ, основанных на каталитической реакции окисления йодида калия ПВ в присутствии молдидбата до свободного йода с последующим измерением светопоглощения трийодида при 351-

352 нм [16-18]. Этот метод позволяет определять от $2 \cdot 10^{-7}$ моль/л ПВ.

Целью настоящего исследования была разработка и валидация спектрофотометрической методики определения остаточных количеств ПВ в промывных водах оборудования производства раствора для инъекций Лидокаина гидрохлорида 20 мг/мл, основанной на этом принципе.

В качестве критерия степени отмывки принято предельное количество ПВ в промывных водах на уровне 10 ppm (мг/л).

Материалы и методы. В исследованиях использовали препарат Лидокаина гидрохлорида раствор для инъекций 20 мг/мл по 2 мл в ампулах (Артериум Корпорация, Украина). Все используемые реактивы были квалификации «хч», их растворы готовили объемно-весовым методом. Титрованные растворы, индикаторы и реактивы готовили и стандартизовали в соответствии с требованиями ГФУ (Государственной Фармакопеи Украины). Возможность применения разработанной методики для определения остаточных количеств ПВ в промывных водах оценивали с помощью процедуры валидации как для испытаний на предельное содержание примесей в соответствии с общей статьей ГФУ [19-21].

Для исследований использовали весы аналитические лабораторные ХР-204S (Mettler-Toledo, Швейцария), спектрофотометр SPECORD 210, фирмы Analytic, Германия; мерную посуду класса А. За исходный раствор принимали пероксид водорода раствор 30%, точную концентрацию которого устанавливали перманганатометрически в соответствии с требованиями ГФУ.

Приготовление модельного раствора пероксида водорода. 0,3 г (точная навеска) исходного раствора «Пероксида водорода 30 %» помещают в мерную колбу объемом 100 мл, доводят объем раствора дистиллированной водой до метки и перемешивают.

1,00 мл полученного раствора помещают в мерную колбу объемом 100 мл, добавляют 0,50 мл разбавленного точно в 10 раз раствора препарата Лидокаина гидрохлорида (1 мг лидокаина гидрохлорида), доводят объем раствора дистиллированной водой до метки и перемешивают (основной модельный раствор). 1,0 мл основного модельного раствора помещают в мерную колбу объемом 10 мл, доводят объем раствора дистиллированной водой до метки и перемешивают. Оптическую плотность испытуемого раствора измеряют трижды относительно компенсационного раствора.

Приготовление компенсационного

Табл. 1.

Результаты проверки специфичности

№ Модельного раствора	$m_{\text{нав}}, \text{г}$	Введено H_2O_2 $X_{\text{введ}}, \%$	A_i	Найдено H_2O_2 $X_{\text{найден}}, \%$	найдено/ введено H_2O_2 $X, \%$ (отн.)	Разница найдено/ введено H_2O_2 100%, %
1	0,2717	0,000830	0,5555	0,000756	91,10	8,88
1	0,2717	0,000830	0,5557	0,000756	91,14	8,86
1	0,2717	0,000830	0,5557	0,000756	91,14	8,86
2	0,3032	0,000926	0,6020	0,000819	88,48	11,52
2	0,3032	0,000926	0,6034	0,000821	88,69	11,31
2	0,3032	0,000926	0,6045	0,000822	88,85	11,15
3	0,3037	0,000927	0,6048	0,000823	88,75	11,25
3	0,3037	0,000927	0,6057	0,000824	88,88	11,12
3	0,3037	0,000927	0,6065	0,000825	88,99	11,01
Требования \leq 16%						Выдерживается

Табл. 2.

Результаты проверки линейности

№ модельного раствора	Содержание H_2O_2 в модельном растворе, %отн.)	$w(\text{H}_2\text{O}_2), C_i,$ %.	№ измерения, j	Оптическая плотность j -го измерения, A_{ij}	Среднее значение A_i
1	15,91	0,000159	1	0,11260	0,113
			2	0,11406	
			3	0,11182	
2	47,17	0,000472	1	0,34264	0,342
			2	0,34203	
			3	0,34129	
3	81,73	0,000817	1	0,59392	0,594
			2	0,59342	
			3	0,59326	
4	97,70	0,000977	1	0,71705	0,717
			2	0,7177	
			3	0,71706	
5	108,35	0,001084	1	0,80243	0,803
			2	0,8031	
			3	0,80386	
6	114,61	0,001146	1	0,84073	0,841
			2	0,84058	
			3	0,84116	
7	118,64	0,001186	1	0,87237	0,873
			2	0,87326	
			3	0,87214	

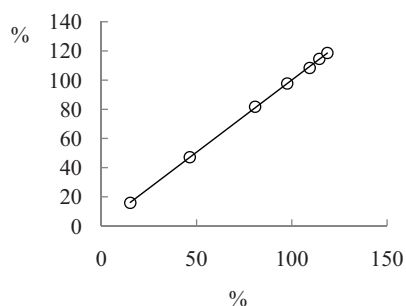


Рис. 1. Зависимость $(A_i/A_{\text{limit}}) \cdot 100$ (Y),
% от $(C_i/C_{\text{limit}}) \cdot 100$ (X), отн.%.
 $R=0,999999$

раствора. 3,00 мл дистиллированной воды вносили в кювету спектрофотометра. В кювету последовательно добавляли несколько кристаллов аммония молибдатотетрагидрата, 3-5 мг тщательно растертого в порошок калия фосфата однозамещенного, и 10-15 мг калия йодида и перемешивали 2-3 мин.

Методика определения. 1,00 мл промывной жидкости переносят а мерную колбу на 10 мл, доводят объем раствора дистиллированной

водой до метки и перемешивают (испытуемый раствор). 3,00 мл испытуемого раствора помещают в кювету спектрофотометра. В кювету последовательно вносят несколько кристалликов молибдата аммония тетрагидрата, 3-5 мг тщательно растертого в порошок фосфата калия однозамещенного и 10-15 мг калия йодида и через 5 минут трижды измеряют светопоглощение раствора при 350 нм по отношению к компенсационному раствору и рассчитыва-

ют среднее значение A_0 . Содержание пероксида водорода, в % (X), рассчитывают по формуле:

$$X = \frac{10 \times A_0}{E_{1\text{см}}^{1\%}}$$

где A_0 – усредненное значение оптической плотности испытуемого раствора после обработки реактивами; $E_{1\text{см}}^{1\%}$ – удельный показатель светопоглощения, который равен 7350.

Специфичность метода была проверена для испытуемого модельного раствора со 100% концентрацией ПВ(10 ppm) от предельной концентрации и концентрации лекарственного препарата (лидокаина гидрохлорида) 10 ppm.

Теоретическую массовую долю ПВ в модельном растворе, в %, рассчитывали по формуле:

$$X_{\text{введено}} = \frac{m_{\text{нав}} \times w_{\text{H}_2\text{O}_2} \times 1}{100 \times 100} = \frac{m_{\text{нав}} w_{\text{H}_2\text{O}_2}}{10000} \quad (1)$$

где $m_{\text{нав}}$ – навеска ПВв г, $w(\text{H}_2\text{O}_2)$ – точно установленная концентрация Пероксида водорода 30%, в %.

Содержание ПВв модельном растворе, в %, рассчитывали по формуле:

$$X_{\text{найденно}} = \frac{10 \times A_{\text{ср}}}{E_{1\text{см}}^{1\%}} \quad (2)$$

где $A_{\text{ср}}$ – усредненное значение оптической плотности испытуемого

Критерии линейности и параметры линейной зависимости

Параметры	Значения	Требования 1	Требования 2	Оценка
b	1,0091			
S_b	0,0056			
a	-0,97	$\leq 1,03 $	$\leq 6,80 $	Выдерживается по первому критерию
Sa	0,51			
RSD_0	0,53			
RSD_0/b	0,53	$\leq 2,53 $		выдерживается
RSD_y	46,186124			
r	0,9999	$> 0,9985 $		выдерживается

Табл.3.

Результаты проверки робастности

№ п/п	Время, час	$A_{i,\text{ср}}$	Введено H_2O_2 $w_{\text{введ}}^{\%}$	Найдено H_2O_2 $X_{\text{найденно}}^{\%}$	Найдено/введено H_2O_2 $X, \%(\text{отн.})$	Разница найденно/введено для H_2O_2 от 100%, %
1	0	0,7173	0,000915	0,000976	106,65	6,65
2	2	0,7171	0,000915	0,000976	106,63	6,63
3	6	0,6152	0,000915	0,000837	91,48	8,52
4	12	0,6057	0,000915	0,000824	90,06	9,94
Требования $\leq 16\%$					Выдерживается	

модельного раствора, полученного после его обработки реактивами; $E_{1\text{см}}^{1\%}$ – удельный показатель светопоглощения, который равен 7350.

Отношение «найденно/введено», в отн. %, рассчитывали по формуле:

$$X_{\text{найденно / введено}} = \frac{X_{\text{найденно}} \times 100}{X_{\text{введено}}} \quad (3)$$

Линейность была исследована в границах диапазона использова-

Табл. 5.

Результаты проверки внутрилабораторной точности

№ исслед.	№ измер.	A _{мод}	Введено H ₂ O ₂ X _{введено} , %	Найдено H ₂ O ₂ X _{найдено} , %	Найдено/ введено для H ₂ O ₂ X ₁ , % (отн.)	X ₁ -100	Требов.
1	1	0,7171	0,00098	0,00098	99,69	0,31	≤ 16,0 %
	2	0,7177					
	3	0,7171					
	среднее	0,7173					
№ исслед. № измер. A _{мод} Введено H ₂ O ₂ X _{введено} , % Найдено H ₂ O ₂ X _{найдено} , %					Найдено/ введено для H ₂ O ₂ X ₂ , % X ₂ -100	Требов.	
2	1	0,71706	0,00097	0,00098	100,61		
	2	0,71702				0,61	≤ 16,0 %
	3	0,71702					
	среднее	0,71703					
						Выдерживается	

Табл. 6.

Результаты проверки границы определения

Введено, %	Найдено, %	Найдено/ Введено, %	Разница найдено/ введено от 100%	Требования
0,000159	0,000153	96,51	3,49	≤ 16,0
0,000159	0,000155			
0,000159	0,000152			
SDa		b	MB	≤ 32,0
0,51172971		1,0090996	1,67	
			Выдерживается	

ния методики в пределах 25-125% от предельной концентрации ПВ в промывной воде. Все последующие расчеты были проведены в нормальной системе координат, где концентрация выражается в отн. % от предельной концентрации ПВ в промывной воде (предельная концентрация $C_{\text{limit}} = 10$ ppm); оптическая плотность для каждого модельного раствора с концентрацией C_i (A_i) выражалась

раствора на протяжении 2,6 и 12 часов.

Внутрилабораторная точность. Выполняли анализ модельного раствора ПВ с концентрацией 100% от граничной концентрации ПВ у промывной воде в соответствии с требованиями методики в разные рабочие дни. Приготовление компенсационного и модельного растворов ПВ как при изучении показателя «Линейность».

Табл.7.

Результаты расчета RSD_p и RSD_{max}

n	$F\ 5\%, n-1$	Требования к RSD_{max}	Гарантируемое RSD
4	2,92	13,60	0,46
3	3,32	9,49	0,49
2	4,17	3,58	0,55

в отн.% от оптической плотности модельного раствора с предельной концентрацией C_{limit} (A_{limit}). При изучении показателя линейность, светопоглощение каждого раствора измеряли трижды. Методом наименьших квадратов была рассчитана линейная зависимость $(A_i/A_{\text{limit}}) \cdot 100 = b \cdot (C_i/C_{\text{limit}}) \cdot 100 + a$ и построен график зависимости.

Робастность: измеряли оптическую плотность модельного раствора ПВ относительно компенсационного

Граница определения. Использовали результаты, полученные при изучении линейности. Границу определения рассчитывали по данным линейной зависимости по формуле: $ПО = 3,3 \cdot SD_a / b$, где SD_a – значение стандартного отклонения свободного члена линейной зависимости; b – значение тангенса угла наклона линейной зависимости.

Пригодность аналитической системы. Подтверждение требований к пригодности аналитической системы

Табл. 8.

Результаты расчета пригодности аналитической системы

$v_k = 2; v_t = 28$

Валидационный показатель	RSD
Специфичность	0,014057; 0,210134; 0,136283
Робастность	0,051922
Линейность	1,007805; 0,197681; 0,058006; 0,051922 0,089085; 0,035805; 0,067789
Внутрилабораторная точность	0,052335; 0,003543
RSD_p	0,27

рассчитывали по результатам, которые были получены в испытаниях на «Специфичность», «Робастность», «Линейность» и «Внутрилабораторная точность».

Результаты и обсуждение. Результаты проверки специфичности представлены в табл.1.

Подтверждено, что наличие лекарственного препарата с концентрацией 100% от предельной концентрации в промывной воде (10 ppm) не влияет на определение ПВ. Результаты проверки линейности представлены в таблице 2.

На рис. 1 представлена линейная зависимость $(A_i/A_{\text{limit}}) \cdot 100$, % от $(C_i/C_{\text{limit}}) \cdot 100$, отн. %.

Критерии линейности и рассчитанные параметры линейной зависимости представлены в табл. 3. Как видно из полученных данных, методика имеет достаточную линейность, так как требования к критериям линейности выполняются.

Результаты проверки робастности представлены в таблице 4.

Результаты проверки внутрилабораторной точности представлены в таблице 5. Результаты эксперимента соответствовали предложенным требованиям.

Результаты проверки границы определения для модельного раствора с концентрацией 15,91% от предельной концентрации ПВ в промывной воде, представлены в таблице 6.

Согласно полученным данным можно сделать вывод о том, что методика удовлетворяет требованиям к границе определения. Результаты расчета RSD_p и RSD_{max} и пригодности аналитической системы представлены в таблице 7 и 8.

Исходя из полученных данных, можно сделать вывод о том, что пригодность аналитической системы подтверждена.

Выводы.

Разработана простая спектрофотометрическая методика и показана возможность применения её для определения остаточных количеств пероксида водорода в промывных водах при контроле качества санитарной отмычки технологического оборудования фармацевтического производства Ли-

докаина гидрохлорида раствора для инъекций 20 мг/мл по 2 мл на уровне 10 ppm.

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ELECTROREDUCTION AT SOLID ELECTRODE MATERIALS AND VOLTAMMETRIC DETERMINATION OF POTASSIUM HYDROGENPEROXOMONOSULFATE

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The electrochemical behaviour of potassium hydrogenperoxomonosulfate (KHSO_5) at carbosital and Au, Ag electrodes using the square-wave voltammetry (SWV) with 0.2 mol L⁻¹ KHSO_4 background solution (pH ~ 0.8) ($E_p = 0.25$ V vs Ag, AgCl/KCl(sat)) and differential pulse voltammetry (DPV) with 0.01 mol L⁻¹ $\text{Na}_2\text{SO}_4 + 8 \times 10^{-3}$ H_2SO_4 background solution (pH = 0.9) ($E_p = 0.14$ V vs Ag, AgCl/KCl(sat)) correspondingly were studied. The voltammetric methods were developed and the possibility to determine the peroxomonosulfate in model solutions on the studied electrodes was shown.

Keywords: potassium hydrogenperoxomonosulfate, voltammetry, carbosital electrode, Ag electrode, Au electrode.

Conference participants, National championship in scientific analytics, Open European and Asian research analytics championship

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Electrochemical analysis is a powerful analytical technique used in pharmaceutical industry and environmental applications. Electroanalysis is highly advantageous due to high sensitivity, reduction in solvent and sample consumption, high-speed, low operating cost and high scan rate in all cases.

An overview of development of electroanalytical chemistry demonstrates that solid electrodes represent the most rapidly growing class of electrodes. When surveying the current state of electroanalytical research and the ways of application of electroanalysis, one concludes that solid electrodes in general are widely used being practical electrode materials. In its broad sense electrochemistry involves a chemical phenomena associated with charge separation at an electrode surface. As voltammetric methods continue to develop, the range of working electrode materials continues to expand, and the analyst must remain aware of what is available. Both the geometry and composition of the working electrode material must be considered since they will influence the performance of the voltammetric method. Also, the physical form of the working electrode may influence the diffusion process, while the working electrode material will influence the chemical steps and the electron transfer process involved in the detection of the analyte.

A great variety of solid electrodes have been employed in different voltammetric techniques over the years. Among the many different solid

materials that can be used as working electrodes, the most common are carbon, platinum and gold [1-8].

Potassium hydrogenperoxomonosulfate (KHSO_5) is one of the most widely used disinfectants in the medical practice, among well-known classes of chemical disinfectants – oxidants. It is included in the new generation of modern disinfection agents in the form of stable triple potassium salt $2\text{KHSO}_5 \cdot \text{KHSO}_4 \cdot \text{K}_2\text{SO}_4$, such as "Perform" and the modified analogue of "Virkon" – "Ecocid S" (KRKA, Slovenia, Novo mesto).

The wide use of KHSO_5 demands a reliable analytical tool for its monitoring. Literature data provide the following methods of the KHSO_5 determination.

The procedure of polarographic determination of sulfuric acid peroxide derivatives such as peroxomonosulfate (Caro's acid) and peroxodisulfate (Marshal acid or persulfate) at dropping mercury electrode (DME) was described [9]. However, strong oxidant reduction such as persulfate in the background solution of 0.03 mol L⁻¹ sulfuric acid at DME was observed at extremely positive potential area vs. saturated calomel electrode (SCE), where the anodic dissolution of electrode material occurred (+0.3 V). In the potential range of +0.3 to +0.15 V (vs. SCE) the diffusion current value maintained constant, and at 0.25 V was proportional to the concentration of potassium persulfate. If the peroxomonosulfate is present in the solution in the form of hydrogenperoxomonosulfate two waves

will overlap, so only their total content can be defined by polarography at DME [10]. In addition to the low selectivity the proposed method is not sensitive, lower limit of detection was limited as absolute value and residual current fluctuations.

The hydrogenperoxomonosulfate was determined by voltammetry in the background of 1 mol L⁻¹ perchloric acid solution using a smooth platinum rotated electrode as a working electrode at +0.214 V (vs SCE) after removal of oxygen during 15 minutes. Only platinum oxide dissolution peak was observed on the background voltammogram at +0.84 V. Platinized platinum electrode through relatively low resistance to oxidation by atmospheric oxygen (which leads to the formation of platinum oxide on its surface) requires advance preparation in order to obtain reproducible potentials, namely holding at +1.4 V for a few minutes to achieve the desired passivation of the electrode surface [11]. This method is not sufficiently sensitive: it allowed determining hydrogenperoxomonosulfate starting from the concentration of 5×10^{-5} mol L⁻¹.

The determination of potassium monoperoxosulfate persisting in some disinfectants in the form of triple salt ($2\text{KHSO}_5 \cdot \text{KHSO}_4 \cdot \text{K}_2\text{SO}_4$) based on titration by tin(II) chloride solution in the presence of potassium bromide at 70 °C with potentiometric registration by means of point platinum and glass pH electrodes was presented. The analysis of «Virkon» solution was performed [12]. The disadvantages of this technique are the necessity to heat the solution of the

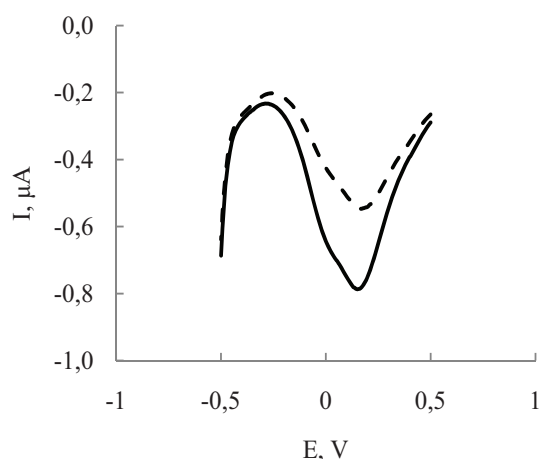
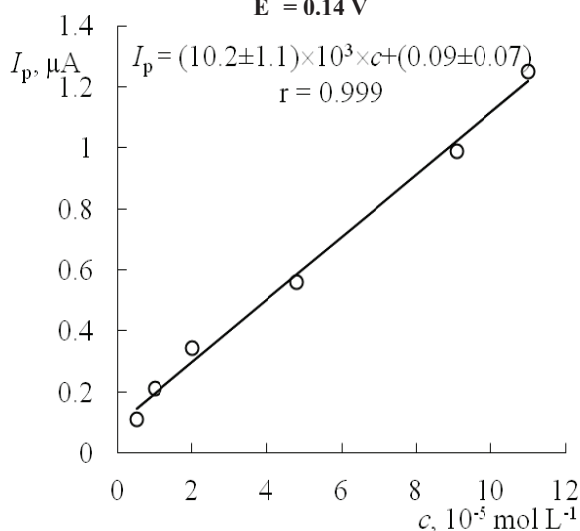


Fig. 1. Voltammogram of the KHSO_5 reduction obtained at Ag (dotted) and Au (straight) electrodes in N_2 -saturated $0.01 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4 + 8 \times 10^{-3} \text{ H}_2\text{SO}_4$ background solution ($\text{pH} = 0.9$) (reference electrode Ag, AgCl/KCl(sat)); $E_p = 0.14 \text{ V}$



1

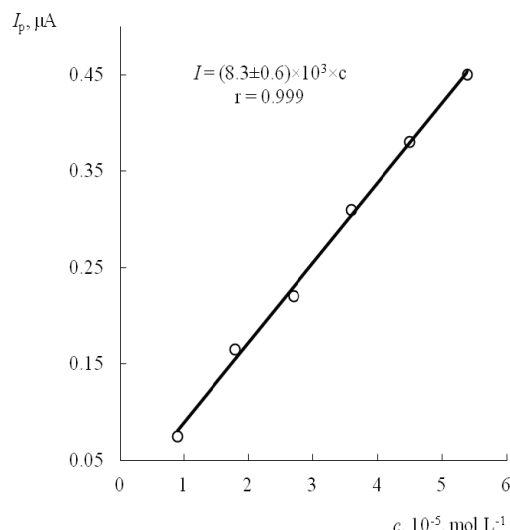
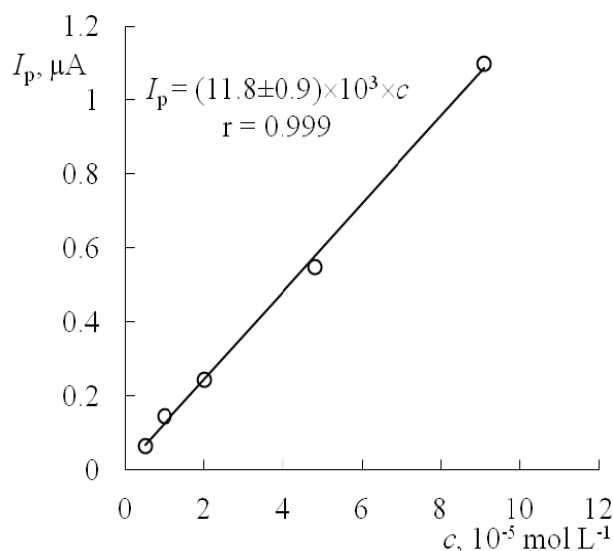


Fig. 2. The calibration plot of the KHSO_5 reduction current peak vs. concentration with $0.2 \text{ mol L}^{-1} \text{ KHSO}_4$ background solution ($\text{pH} \sim 0.8$) at carboxitall electrode (reference electrode Ag, AgCl/KCl(sat)); $E_p = 0.25 \text{ V}$



2

Fig. 3. The calibration plot of the KHSO_5 reduction current peak vs. concentration with $0.01 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4 + 8 \times 10^{-3} \text{ H}_2\text{SO}_4$ background solution ($\text{pH} = 0.9$) at Ag (1) and Au (2) electrodes (reference electrode Ag, AgCl/KCl(sat)); $E_p = 0.14 \text{ V}$

test sample to a temperature of 70°C , and the instability of the titrant solution.

To choose the electrode material, which would have had selectivity measurements in specific circumstances, it is necessary to know the mechanism of the electrode process, the degree of filling of the surface agents changed when the electrode material is changed. Also, notice that the behavior of the electrode is not determined by properties of the metal and thin oxide films on its surface, which strongly differ in electrical characteristics of metals.

Common property of precious metals is good formation of conductive oxide films at anodic potentials.

Allowing for the disadvantages of existing methods, it became necessary to find other electrode materials, and therefore it is perspective to study the behavior of KHSO_5 on silver (Ag) and gold (Au) metal and carboxitall electrodes because the data is not available in the literature.

In the present work the electrochemical behavior of KHSO_5 was examined at metal (i.e., Au, Ag)

and carboxitall electrodes using square wave and differential pulse rotating disk electrode voltammetry. The results of development of the procedure of KHSO_5 quantitative determination using the calibration graph method were shown.

Experimental section

Materials and reagents

The solution of KHSO_5 («Oxone®», ACROS ORGANICS) was freshly prepared and standardized iodometrically. Stock solution was prepared by

Tab. 1.

Regression characteristics of KHSO_5 voltammetric determination procedure in pure substance

Parameters	Data		
	Carbositall	Ag	Au
Concentration ranges (mol L ⁻¹)	$(0.9\text{--}5.4)\times 10^{-5}$	$(0.5\text{--}11.0)\times 10^{-5}$	$(0.5\text{--}9.1)\times 10^{-5}$
Regression equation	$I_p = (8.3\pm 0.6)\times 10^3 \times c$	$I_p = (10.2\pm 1.1)\times 10^3 \times c + (0.09\pm 0.07)$	$I_p = (11.8\pm 0.9)\times 10^3 \times c$
Slope (<i>a</i>)	8.3×10^3	10.2×10^3	11.8×10^3
Intercept (<i>b</i>)	0.006	0.09	0.009
<i>Da</i>	0.6×10^3	1.1×10^3	0.9×10^3
<i>Db</i>	0.05	0.07	0.04
<i>S_a</i>	0.6×10^3	0.4×10^3	0.3×10^3
<i>S_b</i>	0.02	0.02	0.013
Correlation coefficient (<i>r</i>)	0.999	0.997	0.999
LOD (mol L ⁻¹)	2.76×10^{-6}	7.26×10^{-6}	2.48×10^{-6}
LOQ (mol L ⁻¹)	9.19×10^{-6}	2.42×10^{-5}	8.26×10^{-6}

dissolving 0.1537 g of powder (triple potassium salt, $2\text{KHSO}_5\cdot\text{KHSO}_4\cdot\text{K}_2\text{SO}_4$) in 50 mL volumetric flask by double-distilled water to give a concentration of 9×10^{-2} mol L⁻¹. 10 mL of 9×10^{-2} mol L⁻¹ solution of KHSO_5 was diluted in 100 mL volumetric flask with double-distilled water to obtain a 9×10^{-3} mol L⁻¹ solution of KHSO_5 . The stock solution was diluted with the appropriate buffer solution before use. Background solution for carbositall electrode was prepared by dissolving potassium hydrogensulfate (KHSO_4) in volumetric flask by double-distilled water. The background solution for metal electrodes consists of mixture of sulfuric acid (H_2SO_4) and sodium sulfate (Na_2SO_4) solutions.

Electrochemical measurements at carbositall electrode were carried out in the analyzer AVS-1.1 (Volta, St. Petersburg) with a three-electrode scheme by alternating the current

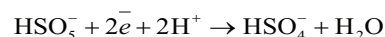
mode with square wave modulation in potential range +1.0...-1.2 V, $W = 1000$ rpm, amplitude 40 mV, $\nu = 65$ Hz. The values of potential peaks directly at a maximum are measured by the electrochemical sensor "Module EM-04" with the accuracy of ± 5 mV. Carbositall electrode was used as a working and an auxiliary electrode, and Ag, AgCl/KCl(sat) electrode type EVL-1M4 - as a reference electrode.

Electrochemical measurements at Ag and Au electrodes were carried out in the Voltammetric measuring stand with the built-in three-electrode scheme potentiostat 797 VA Computrace (Metrohm, Switzerland) by differential pulse mode. For differential pulse voltammetry (DPV) operating conditions were the following: pulse amplitude 0.050 V; pulse width 0.040 s; and scan rate 0.010 V/s. Rotating disk electrodes (RDE) with exchangeable electrode tips made from Ag

or Au were used as a working electrode. Platinum auxiliary electrode with plastic shaft was used as an auxiliary electrode, and Ag, AgCl/KCl(sat) electrode - as a reference electrode.

The pH was measured using the ionmeter type I-160M (Belarus) with the ESL-43-07 type glass electrode paired with Ag, AgCl/KCl (sat) electrode. All measurements were made at the room temperature.

Scheme of the reduction process is:



Activation of the electrode

An important factor in using solid electrodes is the dependence of the response on surface state of the electrode. Accordingly, the use of such electrodes requires precise electrode pretreatment and polishing in order to obtain reproducible results.

Tab. 2.

Evaluation of accuracy and precision of KHSO_5 voltammetric determination procedure ($n = 5$; $P = 0.95\%$)

Electrode material	Taken (mol L ⁻¹)	Found (mol L ⁻¹)	Recovery (% \pm SD)	RSD, %	ε (%)	δ^* (%)
Carbositall	3.6×10^{-5}	$(3.59\pm 0.12)\times 10^{-5}$	99.7 \pm 3.3	2.68	3.3	-0.27
	4.5×10^{-5}	$(4.52\pm 0.14)\times 10^{-5}$	100.4 \pm 3.2	2.55	3.2	+0.44
	5.4×10^{-5}	$(5.41\pm 0.16)\times 10^{-5}$	100.2 \pm 3.0	2.39	3.0	+0.19
Ag	0.99×10^{-5}	$(0.98\pm 0.83)\times 10^{-5}$	100.9 \pm 8.4	6.71	8.3	+0.01
	2.00×10^{-5}	$(2.04\pm 0.15)\times 10^{-5}$	101.8 \pm 7.5	5.95	7.4	+0.02
	11.0×10^{-5}	$(11.5\pm 0.68)\times 10^{-5}$	104.2 \pm 6.2	4.75	5.9	+0.04
Au	0.99×10^{-5}	$(1.10\pm 0.86)\times 10^{-5}$	111.5 \pm 8.7	6.26	7.8	+0.12
	2.00×10^{-5}	$(2.02\pm 0.83)\times 10^{-5}$	101.1 \pm 4.1	3.29	4.0	+0.01
	9.10×10^{-5}	$(9.19\pm 0.32)\times 10^{-5}$	101.0 \pm 3.5	2.88	3.5	+0.01

* relative to the average reference method of iodometric titration [15].

Metallic electrodes were pretreated electrochemically or chemically. The carbosital electrode was polished manually with aqueous slurry of alumina powder on a damp smooth polishing cloth (BAS velvet polishing pad), before measurement.

Results and discussion

Fig. 1 displays the differential pulse voltammetric responses of 2×10^{-5} mol L⁻¹ KHSO₅ at Ag and Au electrodes in N₂-saturated 0.01 mol L⁻¹ Na₂SO₄+ 8×10^{-3} H₂SO₄ background solution (pH = 0.9) (reference electrode Ag,AgCl/KCl(sat)); E_p = 0.14 V. Voltammetric behavior of KHSO₅ at carbosital electrode was shown in [13]. The study was conducted in solutions with concentration of KHSO₅ from 0.9×10^{-5} to 5.4×10^{-5} mol L⁻¹. Background solution was KHSO₄ (c = 0.2 mol L⁻¹, pH ~0.8).

Procedure of obtaining results for the calibration graph

a) Ag and Au electrodes

Solutions of chosen supporting electrolytes were placed into the electrolytic cell at room temperature, and oxygen was removed by transmitting nitrogen through the solution during 2 min. A stock solution of the electroactive compound was added to the final concentration. Nitrogen was introduced for another 1 min and the current-voltage curve was recorded. In the supporting electrolytes used, the current-voltage curves remained unchanged for at least 72 h.

b) Carbosital electrode

Working solutions were prepared by diluting different volumes of stock solution and background solution each in 50 mL volumetric flask using double distilled water. 25 mL of the working solution of pure substance was transferred to the cell.

The voltammograms were recorded by scanning the potential toward the negative direction in the potential range from +1.0 V to -1.2V. The graph was plotted in the coordinates: the height of peaks I_p in μA on the ordinate axis and corresponding concentration of KHSO₅ c in mol L⁻¹ on the abscissa axis.

The calibration curves were obtained based on the limiting currents for the reduction of KHSO₅ at carbosital (Fig.

2) electrode (E_p = 0.25 V vs Ag,AgCl/KCl(sat)) and at Ag (Fig. 3.1) and Au (Fig. 3.2) electrodes (E_p = 0.14 V vs. Ag,AgCl/KCl(sat)).

Analytical characteristics of the calibration graphs of KHSO₅ voltammetric determination procedure are shown in Table 1.

Method validation

Precision and Accuracy

Precision is the degree of repeatability of an analytical method under normal operational conditions. The precision and accuracy were determined with standard quality control samples (in addition to calibration standards) prepared in triplicates at different concentration levels covering the entire linearity range. The precision of the assay was determined by repeatability (intraday) and intermediate precision (interday), and reported as RSD % for a statistically significant number of replicate measurements. The intermediate precision was studied by comparing the assays on three different days, and the results are documented as standard deviation and RSD %. Accuracy is the percent of analyte recovered by assay from a known added amount. Data from nine determinations over three concentration levels covering the specified range was obtained. The repeatability of the method was determined by assaying five sample solutions of the highest test concentration. The obtained results are summarized in Table. 2.

LOD and LOQ

In this study LOD and LOQ were based on the standard deviation of response and the slope of the corresponding curve using the following equations.


$$\text{LOD} = 3 \text{ Sb/a}; \quad \text{LOQ} = 10 \text{ Sb/a},$$





where Sb, the noise estimate, is the standard deviation of the absorbance of the sample, a is the slope of the related calibration graphs. The limit of quantification (LOQ) is defined as the lowest concentration of the standard curve that can be measured with acceptable accuracy, precision and variability (Table 1).

Conclusions

Thus, this report has demonstrated that carbosital and gold electrodes are the most perspective among the studied electrodes. A linear relationship between peak current and concentration was obtained in the range $(0.9-5.4) \times 10^{-5}$ mol L⁻¹ and $(0.5-9.1) \times 10^{-5}$ mol L⁻¹ (r=0.999) of the KHSO₅ concentrations at pH ~0.8. RSD were 2.68 %, 2.55 % and 2.39 % for the 3.6×10^{-5} , 4.5×10^{-5} and 5.4×10^{-5} mol L⁻¹ concentrations of KHSO₅ model solutions, respectively (δ = -0.27...+0.44 %); LOD = 2.76×10^{-6} mol L⁻¹, LOQ = 9.19×10^{-6} mol L⁻¹. While on Au and Ag electrodes this data was the following: RSD were 6.26 %, 3.29 % and 2.88 % for the 0.99×10^{-5} , 2.0×10^{-5} and 9.10×10^{-5} mol L⁻¹ concentrations of the KHSO₅ model solutions, respectively (δ = +0.12...+0.01 %); LOD = 2.48×10^{-6} mol L⁻¹, LOQ = 8.26×10^{-6} mol L⁻¹ on Au electrode. These are the lowest values. On the Ag electrode this data was the following: for the concentrations of the KHSO₅ model solutions 0.99×10^{-5} , 2.0×10^{-5} and 11.0×10^{-5} mol L⁻¹ RSD were 6.71 %, 5.5 % and 4.75 %, respectively (δ = +0.01...+0.04 %); LOD = 7.26×10^{-6} mol L⁻¹, LOQ = 2.42×10^{-5} mol L⁻¹ on Ag electrode. So KHSO₅ determination is more sensitive at carbosital and Au electrodes.

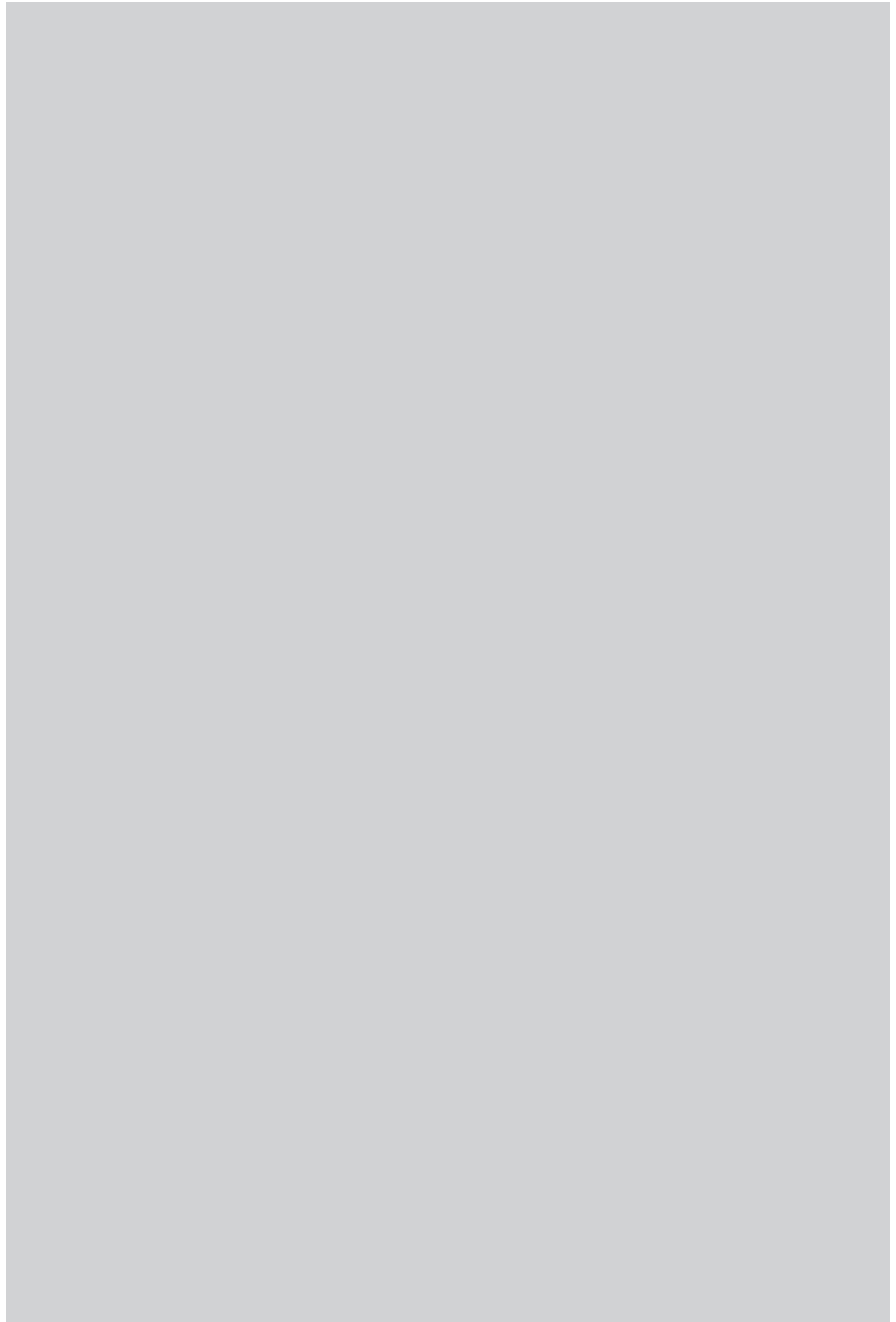
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GISAP Championships and Conferences 2016

Branch of science	Dates	Stage	Event name
JANUARY			
Educational sciences and Psychology	19.01-26.01	I	Modern peculiarities of the identity formation and social adaptation in conditions of the liberal values crisis
FEBRUARY			
Philology	09.02-15.02	I	Theoretical and practical problems of language tools transformation in the context of the accelerated development of public relations
Culturology, Physical culture and Sports, Art History, History and Philosophy	09.02-15.02	I	Cultural and historical development of the society as the dynamic expression of the self-learning human existence
MARCH			
Medicine, Pharmaceutics, Biology, Veterinary Medicine and Agricultural sciences	10.03-15.03	I	Problems of fighting human and animal diseases in terms of the biosphere conditions deterioration
Economics, Jurisprudence and Management, Sociology, Political and Military Sciences	10.03-15.03	I	Social relations and conflicts in conditions of intensification of economic processes and dominance of liberal ideology
APRIL			
Physics, Mathematics and Chemistry, Earth and Space Sciences	06.04-12.04	I	Theoretical and applied problems of physical, mathematical and chemical sciences in the context of the social demand for the knowledge limits expansion
Technical Science, Architecture and Construction	06.04-12.04	I	Methods of effective science-based satisfaction of the increasing social needs in the field of engineering, construction and architecture
MAY			
Educational sciences and Psychology	12.05-17.05	II	Influence of knowledge and public practice on the development of creative potential and personal success in life
JUNE			
Philology	08.06-13.06	II	Issues of preservation of originality and interference of national languages in conditions of globalized international life
Culturology, Physical culture and Sports, Art History, History and Philosophy	08.06-13.06	II	Human creativity phenomenon in ups and downs of the historical process
JULY			
Medicine, Pharmaceutics, Biology, Veterinary Medicine and Agricultural sciences	06.07-12.07	II	Innovative approaches in diagnostics and treatment of human and animal diseases caused by injuries, genetic and pathogenic factors
Economics, Jurisprudence and Management, Sociology, Political and Military Sciences	06.07-12.07	II	Value of the personality and collective interactions in the social progress ensuring process
AUGUST			
Physics, Mathematics and Chemistry, Earth and Space Sciences	04.08-10.08	II	Modern methods of studying matter and interaction of substances, as well as the subject-based relations modeling
Technical Science, Architecture and Construction	04.08-10.08	II	Solving problems of optimal combination of standards of quality, innovative technical solutions and comfort of operation when developing and producing devices and construction objects
SEPTEMBER			
Educational sciences and Psychology	13.09-19.09	III	Harmonious personal development problem in relation to specificity of modern education and socialization processes
OCTOBER			
Philology	05.10-10.10	III	Trends of language cultures development through the prism of correlation between their communicative functions and cultural-historical significance
Culturology, Physical culture and Sports, Art History, History and Philosophy	05.10-10.10.10	III	Significance of personal self-expression and creative work in the course of formation of the society's cultural potential
NOVEMBER			
Medicine, Pharmaceutics, Biology, Veterinary Medicine and Agricultural sciences	10.11-15.11	III	Modern methods of ensuring health and quality of human life through the prism of development of medicine and biological sciences
Economics, Jurisprudence and Management, Sociology, Political and Military Sciences	10.11-15.11	III	Correlation between humanity and pragmatism in target reference points of modern methods of public relations regulation
DECEMBER			
Physics, Mathematics and Chemistry, Earth and Space Sciences	07.12-13.12	III	Object-related and abstract techniques of studying spatio-temporal and structural characteristics of matter
Technical Science, Architecture and Construction	07.12-13.12	III	Current trends in development of innovations and implementation of them into the process of technical and construction objects production

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“Hypothetics: everlasting stories”

Thomas Morgan
Head of the IASHE International Projects Department
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